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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

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The Secretary of the Interior has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Office of Management and Budget through September 1989.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey
MS 425 National Center
Reston, VA 22092

CONTENTS

SUBJECT FIELDS AND GROUPS

Please use the edge index on the back cover to locate Subject Fields and Indexes.

01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES

Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

10 SCIENTIFIC AND TECHNICAL INFORMATION

Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

SELECTED WATER RESOURCES ABSTRACTS

2. WATER CYCLE

2A. General

SOLUTE SOURCES AND TRANSPORT IN AN EPHEMERAL BADLAND CATCHMENT, SOUTHEASTERN ALBERTA, CANADA,
Toronto Univ. (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 2J.
W89-00046

PIPE FLOW IN JAMES BAY COASTAL WETLANDS,
McMaster Univ., Hamilton (Ontario). Dept. of Geography.
M. Woo, and P. DiCenzo.
Canadian Journal of Earth Sciences CJESAP, Vol. 25, No. 4, p 625-629, April 1988. 5 fig, 2 tab, 12 ref.

Descriptors: *Pipe flow, *James Bay, *Overland flow, *Storm runoff, *Wetlands, Groundwater movement, Coastal waters, Darcy's law, Runoff, Surface waters.

Pipes are common along the banks of streams that drain the wetlands of the James Bay (Canada) coast. The primary source of water to the pipes is overland flow, which responds very quickly to rainfall events. Pipe flow, therefore, becomes insignificant shortly after the termination of surface runoff. An assessment of the relative contribution of pipe flow and Darcy's groundwater flow to a small coastal creek shows that whereas groundwater flow contributed less than 1% to summer stormflow, pipes provided about 10% of stream runoff. (Author's abstract)
W89-00047

ROLE OF STORMS IN THE SUMMER SUCCESSION OF THE PHYTOPLANKTON COMMUNITY IN A SHALLOW LAKE (LAKE BALATON, HUNGARY),
Hungarian Natural History Museum, Budapest. Botanical Dept.
For primary bibliographic entry see Field 2H.
W89-00232

RUNOFF GENERATION IN A PLOUGH-DRAINED PEAT BOG IN SOUTHERN SCOTLAND,
Centro de Estudos de Pedologia, Lisbon (Portugal).
For primary bibliographic entry see Field 4C.
W89-00345

STORM RESPONSE OF THE KARSTIC CARBONATE AQUIFER OF SOUTHCENTRAL KENTUCKY,
Nevada Univ. System, Las Vegas. Water Resources Center.
J. W. Hess, and W. B. White.
Journal of Hydrology JHYDA7, Vol. 99, No. 3/4, p 235-252, May 30, 1988. 15 fig, 2 tab, 28 ref.

Descriptors: *Karst hydrology, *Surface-groundwater relations, *Subsurface drainage, *Aquifer characteristics, *Rainfall-runoff relationships, Rainfall disposition, Specific conductivity, Turnhole Spring, Storm events, Temperature, Underground streams, Response time, Water temperature, Kentucky.

Temperature and specific conductance were continuously measured in the downstream drainage of the Turnhole Spring subbasin in the southcentral Kentucky karst. Precipitation was monitored with a rain gage network in the catchment area so that the storm response of specific conductance and temperature could be examined. The aquifer feeding the Turnhole Spring is highly karstic with much of the discharge through integrated open conduits some of which carry water from surface sinking stream catchments. Both temperature and specific conductance fluctuate rapidly in response to storm events. The conductivity curves and to a lesser extent the temperature curves show a sharp dip that lags some hours behind the storm pulse. At the onset of the dip is a complicated sequence of fine structures that is interpreted to be the inputs from conduit tributaries to the master trunk drainage system. The recovery curves have an exponential form that can be fitted to produce a characteristic response time for the conduit system. (Author's abstract)
W89-00349

EFFECT OF LOGGING AND REGENERATION ON GROUNDWATER, STREAMFLOW AND STREAM SALINITY IN THE SOUTHERN FOREST OF WESTERN AUSTRALIA,
Water Authority of Western Australia, Perth.
For primary bibliographic entry see Field 4C.
W89-00350

REPERCUSSIONS OF A CO2 DOUBLING ON THE WATER CYCLE AND ON THE WATER BALANCE - A CASE STUDY FOR BELGIUM,
Institut Royal Meteorologique de Belgique, Brussels. Hydrology Section.
F. Bultot, A. Coppens, G. L. Dupriez, D. Gellens, and F. Meulenberghs.
Journal of Hydrology JHYDA7, Vol. 99, No. 3/4, p 319-347, May 30, 1988. 5 fig, 8 tab, 33 ref.

Descriptors: *Hydrologic cycle, *Hydrologic budget, *Hydrologic models, *Predictions, *Greenhouse effect, *Climatic changes, *Belgium, Carbon dioxide, Catchment areas, Climates, Groundwater recharge, Floods, Seasonal variation, Stream discharge, Surface-groundwater relations.

The impact of the climate change induced by a doubling of the CO2 atmospheric concentration on the hydrologic system is investigated. For this purpose, a daily step conceptual hydrological model (developed at the Royal Meteorological Institute of Belgium) was run for present-day climatic conditions and for the 2 x CO2 case over an eighty-year period. Namely, potential and effective evapotranspiration, soil moisture, snow lying episodes, groundwater storage, flow components at the outlet and water budget were simulated. Three drainage basins in Belgium (Western Europe) were chosen to evaluate the common responses to a CO2 doubling and to bring out differences ascribable to the specific characteristics of each of these catchments. Common responses of the three catchments to a CO2 doubling were a strengthening of the potential and effective evapotranspiration throughout the year, an increased frequency of daily values of the water content of the aeration zone of the soil below 60 or 40% of its capacity at saturation, and a shortening of the spells with snow cover. In catchments where the infiltration rate is high, an increase of the groundwater storage was seen. In catchments where surface flow prevails there was an increase in flood frequencies during winter months, a decrease of the streamflow during the summer season, and possible restraints, in summer and autumn, on water supply from local groundwater storage. (Author's abstract)
W89-00355

VARIATIONS OF RUNOFF IN THE HIGH PLAINS SECTION OF THE SMOKY HILL DRAINAGE, 1951-1980,
Fort Hays State Univ., Hays, KS. Dept. of Earth Science.
J. R. Ratzlaff.
Transactions of the Kansas Academy of Science, Vol. 90, No. 1-2, p 25-34, 1987. 4 fig, 9 ref.

Descriptors: *Rainfall-runoff relationships, *Smoky Hill River, *Runoff, *Kansas, *Flood forecasting, Mathematical studies, Stream discharge, Precipitation, Spatial distribution, Catchment areas, Prediction, Temporal distribution, Comparison studies, Catchment areas, Prediction, Cedar Bluff Reservoir.

The Thiessen polygon method for determining effective uniform depth of precipitation was used to calculate annual precipitation over the Upper Smoky Hill drainage area. Annual stream discharge data were expressed as uniform depths, enabling simple derivation of the runoff ratio in percent. Temporal variations in precipitation, runoff, and runoff ratio are illustrated and described statistically. Cumulative values of precipitation and runoff are plotted as a double-mass curve to show progressive decline in the runoff ratio. Spatial variations in runoff and runoff ratio are illustrated with comparisons of stream discharge for two parts of the drainage area. Hypothetical conditions that would produce substantial inflow into Cedar Bluff Reservoir were developed. (Author's abstract)
W89-00394

LOCAL INFLUENCES ON THE COMPOSITION OF PRECIPITATION ON BERMUDA,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
J. N. Galloway, J. J. Tokos, A. H. Knap, and W. C. Keene.
Tellus TELLAL, Vol. 40B, No. 3, p 178-188, June 1988. 8 fig, 3 tab, 16 ref.

Descriptors: *Bermuda, *Precipitation, *Biogeochemistry, *Rain sampling, Marine environment, Sea salt, Calcium, Sulfates, Hydrogen, Ammonia, Nitrates, Chemical analysis, Evaporation, Atlantic Ocean, Errors.

The island of Bermuda has been used to characterize the composition of precipitation over the western north Atlantic Ocean. However, Bermuda is a small, heavily populated island and the possibility exists that local processes can influence the composition of precipitation. Using 2 years of data on the composition of precipitation at 2 locations on Bermuda, this paper documents that enrichments of sea-salt in Bermuda precipitation, relative to open ocean precipitation, can occur due to ocean-island turbulence. Smaller enrichments of non-sea-salt (nss) Ca(2+), nss SO4(2-), NH4(+), and H(+) are also observed. At present it is not possible to determine whether the enrichments are due to island sources or spatial variability in the precipitation scavenging process. By assuming the latter effect to be negligible, the upper limits of the effect of island sources on the concentrations of the nss components (Ca(2+), SO4(2-), No3(-), H(+)) are about 5-30%, depending on the species. Precipitation associated with westerly airflow is the least affected by local sources. (Author's abstract)
W89-00405

SNAIL DISTRIBUTIONS IN LAKE ERIE: THE INFLUENCE OF ANOXIA IN THE SOUTHERN CENTRAL BASIN NEARSHORE ZONE,
Heidelberg Coll., Tiffin, OH. Water Quality Lab.
K. A. Krieger.
Ohio Journal of Science OJSCA9, Vol. 85, No. 5, p 230-244, December 1985. 1 fig, 4 tab, 36 ref. USEPA Grant ROO5350012 and USEPA contract 68-01-5857.

Descriptors: *Bioindicators, *Anoxia, *Water pollution effects, *Anaerobic conditions, *Lake Erie, *Snails, *Lakes, Species composition, Species diversity, Cuyahoga River, Black River, Grab samplers, Gastropods, Oxygen deficit.

The distributions and abundances of gastropods collected in sediment grab samples in 1978 and 1979 in the southern nearshore zone of the central basin of Lake Erie were compared with earlier gastropod records. Since the 1920's, thirty-four species in eight families have been reported for the lake proper. Sixteen species have been reported only once, thirteen of them in three reports prior to 1950. All but three of the species collected by two or more authors prior to the mid-1950s have also been collected in the past decade. The most frequently reported species are Valvata tricarinata, Bithynia tentaculata, Elimia (= Goniobasis) livescens, Physella sp., Amnicola limosa, Pleurocera acuta and V. sincera. Only six of nineteen studies reported species densities, and most did not record sample locations, depths or substrates. Thus, only a limited comparison of the gastropod fauna between studies was possible, with the exception of several well documented studies in the western basin up to the early 1960s. Of four introduced species in Lake Erie, only two were found in the present study, and these appear to have no influence on the

present distributions of the native species. The absence of snails in the south-western part of the study area and at mouths of the Cuyahoga and Black rivers appears to be the result of prolonged anoxia during one or more summers preceding the study. (Author's abstract)
W89-00683

INTERPRETATION AND MEASUREMENT OF REDOX INTENSITY IN NATURAL WATERS: A COMMENT TO T. FREVERT'S PAPER, 'CAN THE REDOX CONDITIONS IN NATURAL WATERS BE PREDICTED BY A SINGLE PARAMETER',
Eidgenoessische Technische Hochschule, Zurich (Switzerland).
For primary bibliographic entry see Field 2K.
W89-00689

STOCHASTIC FORECAST OF WATER LOSSES,
Ohio Univ., Athens. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7B.
W89-00759

CLIMATE OF THE ESTUARY AND FIRTH OF CLYDE,
University of Strathclyde, Glasgow (Scotland). Dept. of Geography.
For primary bibliographic entry see Field 2L.
W89-00800

MODEL OUTPUT STATISTICS FORECASTS: THREE YEARS OF OPERATIONAL EXPERIENCE IN THE NETHERLANDS,
Royal Netherlands Meteorological Inst., De Bilt.
For primary bibliographic entry see Field 2B.
W89-00843

SOUTHWEST BRANCH OF THE NORTH AMERICAN MONSOON DURING SUMMER 1979,
Centro de Investigacion Cientifica y de Educacion Superior de Ensenada (Mexico).
S. Reyes, and D. L. Cadet.
Monthly Weather Review MRWEAB, Vol. 116, No. 5, p 1175-1187, May 1988. 8 fig, 25 ref. CONACYT Grant PCECBNA-021026.

Descriptors: *Rainfall, *Monsoons, *Mexico, *Weather data collections, *Meteorological data collection, Weather forecasting, Climatology, Water vapor, Anticyclones.

The physical characteristics of the southwest branch of the North American monsoon system during the summer of 1979 were studied with the FGGE dataset. The combined features such as the low pressure trough over northwestern Mexico, the penetration of the easterly flow from the Atlantic Ocean, and the intensification of the anticyclonic gyre of the South Pacific, are responsible, during the summer, for a well established cross-equatorial surface air flow along the eastern tropical Pacific Ocean and western Mexico. Mean monthly maps of vertically integrated water-vapor flux show the development of a low-level jet favoring the penetration, into western Mexico, of a cross-equatorial moist flow which originates over the southern Pacific. It is shown that the South Pacific anticyclone gyre is an important feature which brings moist air along western Mexico. The mean monthly evolution of the net water-vapor flux divergence suggests a strong association with the precipitation pattern observed over Mexico. (Author's abstract)
W89-00845

INTERANNUAL VARIABILITY IN CLIMATE AND FISHERIES IN TASMANIA,
Commonwealth Scientific and Industrial Research Organization, Hobart (Australia). Marine Labs.
G. P. Harris, P. Davis, M. Nunez, and G. Meyers.
Nature NATUAS, Vol. 333, No. 6175, p 754-757, June 1988. 3 fig, 2 tab, 21 ref.

Descriptors: *Fisheries, *Tasmania, *Water temperature, *Seasonal variation, *Climatology, *Weather data collections, *Meteorological data collection, Weather forecasting, Food chains, Water currents, Eutrophication, Climate, Temporal distribution.

Very little is known about the interannual variability of the climate and the fisheries of the Southern Pacific Region. Recent work in the Northern Hemisphere has demonstrated the close relations between interannual variability in climate, the timing of events in the water column, the structure of food chains and recruitment to both marine and freshwater fisheries. Forty years (1945-85) of observations at a coastal station (Maria Island, 42 deg 36 min S, 148 deg 16 min E) in Tasmania showed strong interannual variability in sea-surface temperatures, Maria Island is close to the region of convergence of the surface currents, on the equatorial side of the Subtropical Convergence (STC) water mass boundary. The spring bloom was often extended by as much as three months in some years. Previous work has not offered any explanation for the observed interannual variability and does not show any links with commercial fisheries. The air and sea surface temperature data both show consistent rises in temperature in Tasmania during 1945-1985. Increased pressure at Darwin was correlated with late spring blooms in Tasmania which therefore tended to be more pronounced in El Nino Southern Oscillation years. These changes, together with longer term changes in the air and sea temperatures in the southern Tasman Sea areas have had significant effects on the fisheries of the area. (Alexander-PTT)
W89-00847

PROGRESS IN DEVELOPING AN OPERATIONAL SNOWMELT-RUNOFF FORECAST MODEL WITH REMOTE SENSING INPUT,
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
A. Rango.
Nordic Hydrology NOHYBB, Vol. 19, No. 2, p 65-76, 1988. 8 fig, 2 tab, 10 ref.

Descriptors: *Forecasting, *Runoff forecasting, *Remote sensing, *Snowmelt, *Model studies, *Hydrologic models, Literature review, Streamflow forecasting, Simulation analysis.

In order to apply the snowmelt-runoff model (SRM) or any snowmelt model operationally, a logical progression is required from utilization in the pure simulation mode when all data are known to the pure forecasting mode when no future data are known. Significant progress has been made and results are presented which include pure simulation, simulation when the actual output data are unknown, simulation when estimated or forecasted snow cover input data are employed, simulations or forecasts with updating using observed streamflow, and first attempts at true forecasts. Based on these results, an objective method for forecasting with SRM is being developed. This method must objectively select future snow cover depletion curves and modify the curves based on actual observations. Rational, physically-based, and objective ways to employ updating methods should be applied to input variables and model coefficients as a supplement to updating with actual streamflow. Decisions have to be made on how to employ forecasted or assumed meteorological input variables that are likely to have significant errors. It may also be necessary to provide measures of reliability of SRM forecasts based upon the kind of input data used. (Author's abstract)
W89-00891

ESTIMATION OF CATCHMENT RAINFALL UNCERTAINTY AND ITS INFLUENCE ON RUNOFF PREDICTION,
Technical Univ. of Denmark, Lyngby.
B. Storm, K. H. Jensen, and J. C. Refsgaard.
Nordic Hydrology NOHYBB, Vol. 19, No. 2, p 77-88, 1988. 5 fig, 2 tab, 18 ref.

Descriptors: *Kriging, *Areal precipitation, *Statistical analysis, *Rainfall-runoff relationships, *Hydrologic models, Estimating equations, Precipitation, Denmark.

Interpolation of spatially varying point precipitation depths introduces uncertainties in the estimated mean areal precipitation (MAP). A geostatistical approach, the Kriging method, was used to calculate the daily MAP on a real-time basis. The procedure provides a linear unbiased estimate with minimum estimation variance. The structural analysis of the random precipitation yield is automated by relating the time-varying semivariogram model to the sample variance. This is illustrated on data from a Danish catchment. The conceptual rainfall-runoff model NAM incorporated into a Kalman-filter algorithm was applied to investigate the effects of uncertainties in MAP on the runoff predictions. The study showed a clear filtering effect of the MAP and a reduction in estimation errors on the runoff compared to the estimation errors on the MAP. Measurement and processing errors were not included in the investigation. (Author's abstract)
W89-00892

QUANTITY OF STORMWATER RUNOFF FROM TEN STRETCHES OF ROAD, A CAR PARK AND EIGHT ROOFS IN HERTFORDSHIRE, ENGLAND DURING 1983,
University Coll., London (England). Dept. of Geography.
For primary bibliographic entry see Field 4C.
W89-00912

ASSESSING THE INFLUENCE OF ENVIRONMENTAL PARAMETERS ON THE HYDROLOGICAL CYCLE,
General Hydrological Station of Anhui Province (China).
Y. Yan-Nian, Z. Yiao-Mei, and X. Yi-Chun.
Hydrological Processes HYPRE3, Vol. 2, No. 3, p 285-289, July-September 1988. 1 fig.

Descriptors: *Hydrological cycle, *Hydrologic budget, *Future planning, *Environmental impact, *Hydrologic equation, Meteorological data collection, Hydrologic data collections, Data interpretation.

Human activity is exerting an increasing influence on the hydrological cycle. In order to avoid adverse impacts and to establish optimum conditions for the water balance, it is necessary to understand the role of environmental parameters in influencing the hydrological cycle. Work is currently in progress in China to study the relationships between environmental parameters and the hydrological cycle to provide a basis for planning future development. The water balance parameters of the hydrological cycle and the environment condition parameters can be derived from meteorological and hydrological data and from information on the condition of the earth's surface, respectively, during different periods before or after the environmental changes. However, these data are cyclic in nature and in order to eliminate these effects, analysis should involve the selection of various sequences of environmental conditions to provide equal probability for the occurrence of wet, normal, and dry years. Methods for analyzing the parameters are listed. The development of environmental investigations has not yet fully attained the quantitative stage. In China, the study of this subject area has just been started and there are many research areas to be further developed. (VerNooy-PTT)
W89-00916

MULTIVARIATE PERIODIC ARMA (1,1) PROCESSES,
Genoa Univ. (Italy). Inst. of Hydraulics.
For primary bibliographic entry see Field 7B.
W89-00967

HYDROLOGICAL PERSPECTIVE,
National Hydrology Research Inst., Saskatoon (Saskatchewan).
V. Klemes.
Journal of Hydrology JHYDA7, Vol. 100, No. 1/3, p 3-28, July 30, 1988. 5 fig, 27 ref.

Descriptors: *Hydrology, *Organizations, *Research priorities, *Education, *Scientific personnel, Stream flow, Model studies, Hydrologic models, Hydrologic budget, Data collection, Water management.

Hydrology is regarded a technical discipline rather than a science. Technology and science have different missions and different modes of operation for accomplishing these missions. However, they are locked in a closed loop: technology (doing) stimulates science (thinking) and vice versa. Perhaps three quarters of work done under the label of hydrology is actually technology. The main reason why so much sterile research has been done in hydrology is the fact that it has been directed at finding quick fixes to water management problems. Good technology can exist without scientific knowledge, for example, the Sumerian irrigation systems and the Roman water supply system. However, bad technology results from application of bad science. Some examples of this are deterministic conceptual models and probabilistic hydrological models. Three important reasons why the present era offers an extraordinary opportunity to establish hydrology as one of the geosciences are as follows: (1) the growth of the scale of human interference with nature (from single-well concerns to big dams), (2) the new observational and data handling technologies now available, and (3) the coming era of bio- and geophysical sciences. In order to provide a proper climate for hydrology, several lines of action are possible: (1) restructuring of hydrological education, (2) improvement in teaching of hydrology to students of other disciplines, (3) raising the standards of hydrological publications, and (4) making the International Association of Hydrological Sciences the catalyst of change. (Cassar-PTT)
W89-01011

MACROHYDROLOGY: THE NEW CHALLENGE FOR PROCESS HYDROLOGY,
National Aeronautics and Space Administration, Greenbelt, MD. Hydrological Sciences Branch.
W. J. Shuttleworth.
Journal of Hydrology JHYDA7, Vol. 100, No. 1/3, p 31-56, July 30, 1988. 6 fig, 35 ref, 2 append. EEC, Community Research Program, Stimulation contract ST2J-0049-2-UK (CD).

Descriptors: *Macrohydrology, *Hydrological Atmospheric Pilot Experiment, *Model studies, *Climatology, *Hydrology, *Data acquisition, *Remote sensing, Evaporation, Amazon Region Micrometeorology Experiment, First ISLSCP Field Experiment, Hydrologic models, Meteorology, Vegetation, Process hydrology, Land use, Soil moisture, Atmosphere, Tropical regions, Weather prediction, Agricultural land, Rainfall-runof relationships.

The term macrohydrology encompasses two broad areas: (1) incorporating hydrological expertise into improving the description of land surface properties in the Atmospheric General Circulation Models, thereby improving the reliability of their climate and weather predictions and (2) interpreting the hydrological consequences of any predicted climate change in terms which affect human well-being through the hydrological cycle (flood/drought frequency changes). In macrohydrology the limited resources of computers and model calibration data necessitate the creation of average process descriptions relevant to large areas and loosely defined vegetation types. The area of interest is typically 400 x 400 km. However, the time scale is relatively short, a 12 min time step being typical. Three macrohydrology experiments are described: (1) The Amazon Region Micrometeorology Experiment involved data collection in an undisturbed rain forest over two years. It was determined that spatial variability in precipitation throughfall is very high and can produce large error unless adequately sampled. About 50% of incoming precipitation is re-evaporated. These and other data predict that a land use change to stable grassland or bare soil would reduce annual average evaporation by 10-20%. (2) The objective of the Hydrological Atmospheric Pilot Experiment is to measure and model land surface energy partition on a larger scale in an agricultural-forested area of France. The thrust is investigating the techniques and procedures involved in integrating the different surface-energy partition measured at many sites and over diverse crops to a much larger scale. (3) The aim of the International Satellite Land Surface Climatology Project is to stimulate and conduct research oriented towards evaluating and implementing the use of satellite-based remote sensing data. Observations from these experiments and the results of recent theoretical studies are used to achieve a better definition of the large-scale aggregation process. The use of a one-dimensional model format is supported, with certain specifications regarding vegetative canopy and model parameters. (Cassar-PTT)
W89-01012

STATUS OF ISOTOPE HYDROLOGY TODAY,
B. R. Payne.
Journal of Hydrology JHYDA7, Vol. 100, No. 1/3, p 207-237, July 30, 1988. 8 fig, 46 ref.

Descriptors: *Hydrology, *Stream gaging, *Path of pollutants, *Groundwater movement, *Literature reviews, *Isotope studies, *Tracers, Groundwater recharge, Recharge, Dating, Groundwater dating, Radioactive dating, Flow measurement, Tritium, Sediment transport, Bed load, Rivers, Sediments, Suspended sediments, Boreholes, Hydraulic engineering, Wells, Surface-groundwater relations, Aquifers, Leakage, Runoff, Arid regions, Saline water, Coastal aquifers, Saline water intrusion, Geothermal resources, Waste disposal, Vertical flow.

The present status of isotope hydrology is reviewed with the accent on techniques which are most frequently used, or the potential of which is not fully utilized. Applications are grouped under two headings: (1) those using intentionally introduced tracers and nucleonic instruments and (2) those using environmental isotope techniques. Under the first classification are flow gauging (tritium), sediment transport as bed load (radioactively labeled sand and pebbles) and as suspended sediment (nucleonic scattering gages), measurement of flow and flow direction in boreholes, and estimation of recharge (tritium). The second classification of techniques (generally using tritium and carbon-14) is used in recharge and dating of groundwater, elevation of recharge area, runoff studies, arid zone hydrology, interaction of surface water with groundwater, leakage between aquifers, mechanisms of salinization, assessment of geothermal resources, and in siting of waste disposal dumps. (Cassar-PTT)
W89-01018

REMOTE SENSING IN HYDROLOGY,
Ruhr Univ., Bochum (Germany, F.R.). Inst. for Hydrology, Water Resources and Environmental Engineering.
G. A. Schultz.
Journal of Hydrology JHYDA7, Vol. 100, No. 1/3, p 239-265, July 30, 1988. 13 fig, 1 tab, 26 ref.

Descriptors: *Hydrology, *Data acquisition, *Remote sensing, *Literature reviews, Model studies, Hydrologic data, Microwaves, Satellite technology, Flood forecasting, Forecasting, Mathematical models, Land use, Runoff, Hydrologic models, Evapotranspiration, Soil water, Rainfall, Snow, Ice, Groundwater mining, Sediments, Water quality.

Remote sensing has many applications in collection of hydrologic data. In hydrology electromagnetic energy is the most important medium used in remote sensing. In passive remote sensing only natural energy emitted from the target is measured, while in active remote sensing artificially generated signals are transmitted and the return signals measured. Remote sensing platforms to which the sensors are attached include ground observation platforms, balloons, aircraft and remotely piloted vehicles, rockets, and satellites. Types of sensors are aerial photography, scanning radiometers spectrometers, and microwave radars. The structures of mathematical hydrologic models which use remote sensing information are analyzed. Remote sensing cannot directly measure hydrologic data. It can only measure electromagnetic signals which can be converted into hydrologic data, easily, as in the case of snow cover, but with difficulty in most other cases. The simplest model is a regression type; more complex models include a single input-single output model of the lumped type and a distributed system model. Remote sensing may also be very useful in estimating model parameters such as land use classification. Three examples of remote sensing application in hydrologic modeling are given: (1) model parameter estimation with the aid of multispectral Landsat satellite data; (2) computation of historic monthly runoff for design purposes with the aid of a lumped system model using NOAA infrared satellite data as input; and (3) real-time flood forecasting applying a distributed system model using radar in the field of evapotranspiration, soil moisture, rainfall, surface water, snow and ice, sediments, and water quality. Data can be obtained from space agencies, from public or commercial institutions, or obtained from aircraft. Although some computer software is available to process this data, many hydrologists develop their own software for their specific application. (Cassar-PTT)
W89-01019

HILLSLOPE RUNOFF PROCESSES AND MODELS,
Leeds Univ. (England). School of Geography.
M. Kirkby.
Journal of Hydrology JHYDA7, Vol. 100, No. 1/3, p 315-339, July 30, 1988. 5 fig, 67 ref.

Descriptors: *Hydrology, *Precipitation, *Rainfall-runoff relationships, *Literature reviews, *Runoff, *Slopes, *Model studies, Infiltration, Saturated flow, Subsurface flow, Overland flow, Catchments, Percolation, Soil water, Flow pattern, Forecasting, Vertical flow.

Hillslope hydrology is concerned with the partition of precipitation as it passes through the vegetation and soil between overland flow and subsurface flow. Flow follows routes which attenuate and delay the flow to different extents, so that a knowledge of the relevant mechanisms is important. In the 1960s and 1970s hillslope hydrology developed as a distinct topic through the application of new field observations to develop a generation of physically based forecasting models. In its short history, theory has continually been overturned by field observation. Thus the current tendency, particularly among temperate zone hydrologists, to dismiss all Hortonian overland flow as a myth, is now being corrected by a number of significant field studies which reveal the great range in both climatic and hillslope conditions. Some recent models have generally attempted to simplify the processes acting, for example including only vertical unsaturated flow and lateral saturated flows. Others explicitly forecast partial or contributing areas. With hindsight the most complete and distributed models have generally shown little forecasting advantage over simpler approaches, perhaps trending towards reliable models which can run on desk top microcomputers. The variety now being recognized in hillslope hydrological responses should also lead to models which take account of more complex interactions, even if initially with a less secure physical and mathematical basis than the Richards equation. In particular, there is a need to respond to the variety of climatic responses, and to spatial variability on and beneath the surface, including the role of seepage macropores and pipes which call into question whether the hillside can be treated as a Darcian flow system. (Author's abstract)
W89-01022

RAINFALL-RUNOFF MODELING: PAST, PRESENT AND FUTURE,
Bologna Univ. (Italy).
E. Todini.
Journal of Hydrology JHYDA7, Vol. 100, No. 1/3, p 341-352, July 30, 1988. 1 tab, 55 ref.

Descriptors: *Hydrology, *Rainfall-runoff relationships, *Runoff, *Literature reviews, *Model

studies, *Mathematical models, Stochastic hydrology, Unit hydrographs, Hydrograph analysis.

Rainfall-runoff modeling originated in the second half of the 19th century as a response to problems in urban sewer design, land reclamation drainage systems design, and reservoir spillway design. At the turn of the century empirical methods and the rational method were commonly used. During the 1920s the rational method was modified to cope with the nonuniform distribution of rainfall and catchment characteristics. In 1932 the unit hydrograph was introduced on the basis of the superposition principle. The objectivity of the unit hydrograph was improved during the thirties and forties. In the fifties, new understanding of the unit hydrograph was realized, and conceptual models were developed and subsequently improved. Other modeling approaches to rainfall-runoff modeling were considered in the sixties. These involved interconnected conceptual elements. Problems in these models led to development of the SHE (Systeme Hydrologique Europeen) model, which allows simulation of the internal as well as external effects of catchment behavior. Pollution, erosion, land use, and anthropization were concerns in the seventies. A real-time forecasting model was developed in the early eighties. Currently used models can be classified as purely stochastic models, lumped integral models, distributed integral models, distributed differential models, and models for estimating parameters. Future needs are involved with accidental pollution, drought and flood management, acid rain, soil degradation, and nonpoint source pollution. Simplified models are also needed for water balance and water resources management studies. (Cassar-PTT)
W89-01023

HYDROLOGICAL HETEROGENEITY CATCHMENT MORPHOLOGY AND CATCHMENT RESPONSE,
Lancaster Univ. (England). Centre for Research on Environmental Systems.
K. J. Beven, E. F. Wood, and M. Sivapalan.
Journal of Hydrology JHYDA7, Vol. 100, No. 1/3, p 353-375, July 30, 1988. 6 fig, 95 ref. U.S. NASA Grant NAG-5-491, U.S. Dept. of Interior Grant 14-08-0001-G1138 and United Kingdom NERC Grant GR3/6264.

Descriptors: *Hydrology, *Rainfall-runoff relationships, *Streamflow, *Geomorphology, *Heterogeneity, *Channel morphology, *Literature reviews, Catchment areas, *Runoff, Hydrographs, Infiltration, Stream order, Routing, Hortons law.

Catchment morphology and hydrologic processes are linked through the geomorphic development of a catchment. The effects of morphology on water flows are reviewed, viewing catchment form as one source of spatial heterogeneity in catchment response. Morphology recorded on today's topographic maps are likely to be a reflection of hydrologic regimes of the distant past rather than a product of interdependence with the present water flows. Runoff routing was studied by several authors including Horton, who developed the ordering system for streams. Methods of physically-based flood frequency predictions that combine production and routing are described. The relationship between morphology and other sources of spatial heterogeneity in catchment response is examined, including the concept of the representative elementary area, which is the scale of minimum variance for predicting runoff production. (Cassar-PTT)
W89-01024

OPERATIONAL MODELS FOR FLOOD CALCULATIONS,
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Hydrologie und Wasserwirtschaft.
E. J. Plate, J. Ihringer, and W. Lutz.
Journal of Hydrology JHYDA7, Vol. 100, No. 1/3, p 489-506, 1988. 9 fig, 2 tab, 21 ref.

Descriptors: *Operational hydrology, *Rainfall-runoff relationships, *Rainfall-runoff models, *Rivers, *Flood forecasting, Design floods, Flood protection, Reservoirs, Catchment basins, Model studies, Flood routing, Runoff, Hydrologic models, Water storage, Hydrographs, Urban hydrology, Brettach River, Federal Republic of Germany, Unit hydrographs.

The IHW (Institute for Hydrology and Water Resources) model was developed over 15 years of research to calculate design floods for flood protection reservoirs. The model requires subdividing a catchment into small subcatchments which can be connected to form a basin model. The flood from each subbasin is calculated from a design rainfall pattern convoluted with a unit hydrograph. Runoff coefficients and unit hydrographs are calculated from a regionalization model which has been developed from a large number of measured hydrographs. Flood routing models are used to connect the subcatchments. The model was applied to a study of the Brettach River, a small river with a catchment of 156 sq km. A flood event of May 1983 was used for fine-tuning the model. The model is in wide use in the Federal Republic of Germany, where gently rolling country prevails. (Cassar-PTT)
W89-01030

PROBLEMS OF RAINFALL-RUNOFF MODELLING IN ARID AND SEMIARID REGIONS,
New South Wales Univ., Kensington (Australia). School of Civil Engineering.
For primary bibliographic entry see Field 2E.
W89-01144

ROLE OF SOIL ORGANIC MATTER IN THE GEOCHEMICAL CYCLING OF CHLORIDE AND BROMIDE,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Water Resources.
R. G. Gerritse, and R. J. George.
Journal of Hydrology JHYDA7, Vol. 101, No. 1-4, p 83-95, June 30, 1988. 6 fig, 1 tab, 36 ref.

Descriptors: *Hydrologic cycle, *Geochemistry, *Soil organic matter, *Chlorides, *Bromides, *Leaching, Chlorine, Bromine, Australia, Chemistry of precipitation, Soil water, Chemical properties, Geochemistry.

Chloride to bromide ratios were determined for rainfall in Western Australia and groundwaters and surface waters from a number of catchments in Western Australia, Victoria and Queensland. The ratio in rainfall, though showing a large short-term scatter, on average reflected the ratio in ocean water. Groundwaters and surface waters often showed characteristic differences in Cl(-)/Br(-), presumably associated with the cycling of bromide through soil organic matter. To prove this association it is shown that in the leachate of saturated small columns of soil the Cl(-)/Br(-) ratio is governed by chloride and bromide released from decomposing organic matter. On leaching the columns of soil the Cl(-)/Br(-) weight ratio decreased rapidly from a high 300, reflecting rainfall, to a low 10, reflecting the ratio of chlorine to bromine bound to soil organic matter. (Author's abstract)
W89-01200

RUNOFF GENERATION IN A LOW ARCTIC DRAINAGE BASIN,
York Univ., North York (Ontario). Dept. of Geography.
N. T. Roulet, and M. K. Woo.
Journal of Hydrology JHYDA7, Vol. 101, No. 1-4, p 213-226, June 30, 1988. 5 fig, 18 ref.

Descriptors: *Rainfall-runoff relationships, *Tundra, *Catchment areas, *Wetlands, *Arctic, Runoff, Melting, Snowmelt, Permafrost, Seasonal variation, Topography, Canada.

The production of runoff from a small drainage basin in the continuous permafrost area of continental Canada was studied for two years. The basin comprises two main land types (dry tundra slopes and valley bottom wetlands) and several lakes. In spring, meltwater from most parts of the basin contributed to total runoff but the magnitude and timing of slope and wetland runoff differed. In summer this difference in runoff production was more marked. In both seasons the base of the slopes initiated runoff, which increased significantly once the wetlands began to discharge. The combined runoff mechanisms of the two land types and the linkages between them provide a general framework for an understanding of runoff generation in low Arctic basins. (Author's abstract)
W89-01207

IDENTIFICATION OF A MULTIPLE INPUT, SINGLE OUTPUT, LINEAR, TIME INVARIANT MODEL FOR HYDROLOGICAL FORECASTING,
University Coll., Galway (Ireland). Dept. of Engineering Hydrology.
For primary bibliographic entry see Field 7C.
W89-01209

ENHANCEMENT OF RUNOFF FROM A SMALL WATERSHED BY CLOUD SEEDING,
Ministry of Agriculture, Jerusalem (Israel). Hydrological Service.
For primary bibliographic entry see Field 3B.
W89-01212

MAXIMUM ENTROPY SPECTRAL ANALYSIS OF HYDROLOGIC DATA,
North Dakota State Univ., Fargo. Dept. of Civil Engineering.
G. Padmanabhan, and A. Ramachandra Rao.
Water Resources Research WRERAO, Vol. 24, No. 9, p 1519-1533, September 1988. 10 fig, 2 tab, 33 ref.

Descriptors: *Hydrologic data collections, *Spectral analysis, *Entropy, *Stochastic hydrology, Mathematical studies, Time series analysis, Comparison studies, Correlation analysis, Model studies, Climatology.

Determination of periodicities is a frequently-encountered problem in stochastic analysis of hydrologic time-series data. Several aspects of the application of maximum-entropy spectral analysis (MESA) to hydrologic time series are discussed in this paper. The performance of the MESA method is compared with the commonly-used Blackman and Tukey method. MESA can be extended to obtain additional stochastic characteristics such as autocorrelation, partial autocorrelation, inverse autocorrelation, inverse partial autocorrelation and cross spectra of time-series data. Thus spectral analysis and computations related to stochastic model development may be integrated by using MESA. The simple relationship between maximum-entropy and maximum-likelihood spectra may be used to filter out pseudoperiodicities that occur in maximum-entropy spectra estimated by using large filter orders. The MESA method is a powerful technique which can be usefully employed in the analysis of hydrologic and climatologic data. (Author's abstract)
W89-01248

COMPARISON OF MODEL-GENERATED AND SATELLITE-DERIVED CLOUD COVER AND RADIATION BUDGET,
Lille-1 Univ., Villeneuve d'Ascq (France). Lab. d'Optique Atmospherique.
J. C. Buriez, B. Bonnel, Y. Fouquart, J. F. Geleyn, and J. J. Morcrette.
Journal of Geophysical Research (D) JGRDE3, Vol. 93, No. 4, p 3705-3719, April 20, 1988. 19 fig, 3 tab, 42 ref.

Descriptors: *Cloud cover, *Weather forecasting, *Climatology, *Relative humidity, *Shortwave albedo, *Radiation, *Model studies, Weather, General circulation model, Satellite technology, Radiation budget.

Using a data set including large-scale fields and collocated satellite observations (the NEPHOS file), the validity of the approach proposed for validating general circulation model type cloud schemes were tested using the future International Satellite Cloud Climatology Project (ISCCP) and

First ISCCP Regional Experiment (FIRE) data sets. An ensemble of 2866 atmospheric situations extracted from the NEPHOS file is used to test the European Center for Medium Range Weather Forecasts operational cloud cover scheme and to test the sensitivity to cloud cover of the regional radiation budget over the eastern Atlantic Ocean and North Sea. This scheme, based on a simple function of the relative humidity, underestimate the cloud cover (by 26%) especially when stratocumulus clouds are present. This underestimation is related to too small values of the analyzed relative humidity in the model's planetary boundary layer. The vertical gradient of potential temperature is a better predictor for this low-level cloudiness. Differences between the observed and generated radiation budget at the top of the atmosphere are induced by differences in the cloud cover. However, differences in the cloud radiative properties introduce some compensating effects, and the mean bias error is only +7 W/m squared. The mean value of the shortwave albedo is too high in the model, and its variation as a function of the cloud cover is much too smooth, as the model does not account for the observed increase in the optical depth of clouds when the cloud cover increases. (Author's abstract)
W89-01262

2B. Precipitation

SECONDARY ICE NUCLEUS GENERATION BY SILVER IODIDE APPLIED TO THE GROUND,
Commonwealth Scientific and Industrial Research Organization, Aspendale (Australia). Div. of Atmospheric Research.
For primary bibliographic entry see Field 3B.
W89-00088

WINTER DIURNAL TRENDS OF SIERRA NEVADA SUPERCOOLED LIQUID WATER AND PRECIPITATION,
Electronic Techniques, Inc., Auburn, CA.
For primary bibliographic entry see Field 3B.
W89-00089

MODIFIED ATI TECHNIQUE FOR NOWCASTING CONVECTIVE RAIN VOLUMES OVER AREAS,
Universidade Estadual Paulista, Botucatu (Brazil). Dept. of Zoology.
A. A. Doneaud, A. Makarau, and L. R. Johnson.
Journal of Applied Meteorology JAMOAX, Vol. 27, No. 4, p 491-502, April 1988. 13 fig, 4 tab, 9 ref. NASA Grant NAG-5-386; North Dakota Weather Modification Board Contract WMB-IAS-85-I.

Descriptors: *Rainfall, *Convective precipitation, *Rainfall area, *Area-time integrals, Precipitation, Radar, Regression analysis, Statistical analysis, Storms, Correlation analysis, Correlation coefficient, Nowcasting, North Dakota.

Digital radar data from the North Dakota Cloud Modification Project were used to investigate the relationship between convective rain volumes and area-time-integrals (ATI). The ATI technique provides a means of estimating total rain volumes using area covered by rain events integrated over the cluster duration.A simple linear regression analysis demonstrated strong correlations between total rain volume (TVR) or the maximum rain volume (MVR) versus ATIs computed using the maximum echo area (ATIA). In a log-log plot, the correlation coefficient and the standard error of estimates of total rain volume versus ATIA were 0.98 occur in rain volume estimates obtained from radar data employing Z-R conversion followed by space and time integration, and demonstrates that the total rain volume of a storm can be nowcasted at its maximum stage of development. (Max ATIA). (Author's abstract)
W89-00090

PERSISTENT EFFECTS OF CLOUD SEEDING WITH SILVER IODIDE,
Commonwealth Scientific and Industrial Research Organization, Aspendale (Australia). Div. of Atmospheric Research.
For primary bibliographic entry see Field 3B.
W89-00091

CHANGES IN RAINWATER ACIDITY ASSOCIATED WITH CLOSURE OF A COPPER SMELTER,
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-00272

TEXAS DROUGHT HISTORY RECONSTRUCTED AND ANALYZED FROM 1698 TO 1980,
Arkansas Univ., Fayetteville. Dept. of Geography.
D. W. Stahle, and M. K. Cleaveland.
Journal of Climate, Vol. 1, No. 1, p 59-74, January 1988. 6 fig, 4 tab, 55 ref, append. NSF Grants ATM-8006964, ATM-8120615, ATM-8412912 and ATM-8612343.

Descriptors: *Droughts, *Texas, *Meteorological data collection, *History, *Dendrochronology, *Model studies, *Weather forecasting, *Statistical methods, Mathematical studies, Climatology, Regional analysis, Annual variation, Weather, Rainfall, Regression analysis, Time series analysis, Principal component analysis.

A selected group of nine climate-sensitive tree-ring chronologies from old post oak trees were used to reconstruct the June Palmer Drought Severity Index (PDSI) from 1698 to 1980 for two large regions in northern and southern Texas. Analysis of tree growth and monthly climate variables indicate that the June PDSI is the most robust climate signal evident in these chronologies, and principal component analysis (PCA) reveals a north-south geographic pattern in the relationships between the regional tree-ring time series. Regression models explain 59% and 60% of the variance in north and south Texas June PDSI, respectively, and are well verified against independent June PDSI data available on a statewide basis from 1888 to 1930. The weak persistence present in the observed June PDSI series was added to the serially random tree-ring reconstructions prior to verification, using autoregressive modeling procedures. The mean and variance of June PDSI during the 50-yr period of meteorological observation (1931-80) appear to be representative of the last 283 yr, but significant changes in average June PDSI for Texas appear to have occurred over both 30 and 90-yr time intervals. The reconstructions faithfully reproduce the frequency domain properties of the actual June PDSI, and marginally significant spectral peaks are present at 2.3 yr and between 14 and 18.67 yr in both reconstructions. Significant interannual persistence of June moisture extremes apparent in the statewide June temperature, precipitation, and PDSI data from 1988 to 1982 is also present in both regional reconstructions from 1698 to 1980. The reconstructions indicate that the risk for below average June moisture conditions increases to at least 65% in north and south Texas in the summer following a June drought. Interannual persistence is also indicated for June wetness anomalies and may have some modest value in statistical forecasts of growing season moisture conditions in Texas. (Author's abstract)
W89-00273

CLIMATOGRAPHY OF THUNDER EVENTS IN THE CONTERMINOUS UNITED STATES: PART I: TEMPORAL ASPECTS,
Rochester Univ., NY.
S. A. Changnon.
Journal of Climate, Vol. 1, No. 4, p 389-398, April 1988. 10 fig, 14 ref. NSF Grant ATM-8610028.

Descriptors: *United States, *Thunder, *Temporal distribution, *Climatology, *Seasonal variation, *Storm duration, Spatial distribution, Meteorological data collection, Time series analysis, Cyclones, Regional analysis, Weather, Storms.

Average durations of thunder events are greatest (> 120 min) in the Oklahoma-Kansas area and least (< 60 min) along the west coast and northeast. The average annual point duration of thunder activity ranges from 10,000 to 12,000 min along the Gulf Coast, 8000 to 10,000 min in the Midwest, exceeds 6000 min in Arizona, but is only 1000 to 2000 min in the northeast, and 500 to 1000 min along the west coast. Nocturnal thunder events typically last 10 to 30 min longer than those in the daytime in all areas except for the western mountains and extreme southeast where daytime events exceed those at night by 5 to 15 min, on the average. The trends in thunder event activity during the 1948-77 period indicate four distinctly different characteristics. The stations in the southwestern and northwestern United States exhibit flat, unchanging trends in events during the 30 years, but events in the northern Great Plains-Midwest gradually decreased with time; those in the Great Lakes increased since 1950; and those in the southeastern United States decreased to minimums in the 1960s and then increased to 1977. The temporal distribution of extratropical cyclonic activity in July explains 25% to 50% of the temporal variations in July thunder events over most of the central and eastern United States. However, increases in thunder events since the late 1960s in the Upper Midwest and along the East Coast were not associated with increased cyclonic activity. (See also W89-00275) (Author's abstract)
W89-00274

CLIMATOGRAPHY OF THUNDER EVENTS IN THE CONTERMINOUS UNITED STATES: PART II: SPATIAL ASPECTS,
Rochester Univ., NY.
S. A. Changnon.
Journal of Climate, Vol. 1, No. 4, p 399-405, April 1988. 6 fig, 10 ref. NSF Grant ATM-8610028.

Descriptors: *United States, *Thunder, *Storm frequency, *Seasonal variation, *Spatial distribution, *Climatology, Meteorological data collection, Time series analysis, Regional analysis, Weather, Storms.

The average temporal and spatial distributions of thunder events (periods of discrete thunder activity heard at a point) in the conterminous United States were found to be generally similar to those of thunder days. Annual averages of thunder events peak along the Gulf Coast (> 100) and are also quite high in the central United States (Kansas, Missouri, Illinois with > 75 events), and in the southwest (Arizona with 60 events). Thunder events are least along the west coast (< 20) and in the northeast (< 30). Multiple events per day are greatest in the Midwest (Illinois, Iowa) averaging 1.7 events per summer day, and are also high in the southwest (Arizona) with 1.5 events. This causes these two maxima in thunder event activity to be more pronounced than those found on the pattern of average thunder days. The average patterns for the thunder event frequencies, multiple events per day, and durations reveal that convective activity is weakest and shortlived along the west coast and in the northeast. The high incidence of events per day in the Midwest reflects multiple storm incidences likely related to mesoscale convective complexes and nocturnal storm activity. The peak in thunder event activity is present in the central United States in all months and rotates from the lower Mississippi Valley to the central Great Plains-Midwest and then back, and its position is always closely related to the major center of cold frontal activity. The thunder peak in the southwest is related to the summer monsoon intrusion of moist tropical Pacific air and related frontal activity. The summer-fall peak in thunder events along the Gulf Coast-Florida is a result of sea breeze induced convergence, localized heating, and occasional tropical disturbances. (See also W89-00274) (Author's abstract)
W89-00275

EL NINO-SOUTHERN OSCILLATION AND RAINFALL VARIABILITY,
Bureau of Meteorology, Melbourne (Australia). Research Centre.
N. Nicholls.
Journal of Climate, Vol. 1, No. 4, p 418-421, April 1988. 3 fig, 2 tab, 4 ref.

Descriptors: *El Nino, *Southern Oscillation, *Rainfall, *Annual variation, *Variability, *Meteorological data collection, *Weather data collections, *Climatology, Adaptation, Evolution, Weather.

Data originally published by Conrad in 1941 were reexamined to determine whether El Nino-Southern Oscillation (ENSO) causes 'excess' variability outside the immediate El Nino area of the equatorial east Pacific and the Pacific coast of South America. The variability in annual rainfall tends to be substantially higher in areas affected by ENSO, even outside the immediate area of influence of the El Nino. It seems reasonable to conclude that this higher variability is due to ENSO. Not only are fluctuations in ENSO related to rainfall fluctuations over large areas of the globe, but ENSO also amplifies, typically by one-third to one-half for most stations, the magnitude of the interannual rainfall fluctuations in these areas. Areas affected by ENSO are truly lands 'of droughts and flooding rains'. A more substantial concern deserving further study is the possible impact of this 'excess,' ENSO-related variability. If the ENSO phenomenon has operated for a long period, e.g., thousands of years, the higher rainfall variability in ENSO-affected areas must have influenced the evolution of physiography, fauna, and flora. If wildlife which adapted to higher rainfall variability tends to be concentrated in areas now affected by ENSO, this might suggest that the ENSO phenomenon has indeed existed for a very long time. (Alexander-PTT)
W89-00276

FIELD STUDY OF THE CLOUD CHEMISTRY AND CLOUD MICROPHYSICS AT GREAT DUN FELL,
University of Manchester Inst. of Science and Technology (England). Dept. of Physics.
For primary bibliographic entry see Field 5B.
W89-00308

DETERMINATION OF MONO- AND DIVALENT CATIONS AND ANIONS IN SMALL FOG SAMPLES BY ION CHROMATOGRAPHY,
Paul Scherer Inst., Wuerenlingen (Switzerland).
For primary bibliographic entry see Field 5A.
W89-00372

LOCAL INFLUENCES ON THE COMPOSITION OF PRECIPITATION ON BERMUDA,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 2A.
W89-00405

RELATIONSHIP BETWEEN DELTA-D AND DELTA-18-O VALUES OF FALLING SNOW PARTICLES FROM A SEPARATE CLOUD,
Nagoya Univ. (Japan). Water Research Inst.
For primary bibliographic entry see Field 2C.
W89-00406

EVOLUTION AND FINE STRUCTURE OF A LONG-LIVED MESO-ALPHA-SCALE CONVECTIVE SYSTEM IN A BAIU FRONTAL ZONE. PART II: MESO-GAMMA-SCALE CHARACTERISTICS OF PRECIPITATION,
Japan Meteorological Agency, Tokyo. Numerical Prediction Div.
K. Ninomiya, T. Akiyama, and M. Ikawa.
Journal of the Meteorological Society of Japan JMSJAV, Vol. 66, NO. 2, p 351-371, April 1988. 25 fig, 35 ref.

Descriptors: *Mesoscale convection, *Convective precipitation, *Frontal zone, *Weather, *Precipitation, Japan, Meteorology, Wind shear, Orography.

Part I of the present study showed that a long lived meso-alpha-sale convective system (M alpha CS) during 14-15 July 1979, which was accompanied by a weak Baiu frontal depression, consisted of meso-beta-scale convective systems (M beta CSs) and the development/decay and movement of M beta CS had strong influence on the behavior of the M alpha CS. In part II, the fine structure of precipitation was studied using dense surface observation data over western Japan (Kyushu). M beta CSs consisted of a few meso-gamma-scale convective systems (M gamma CSs), which had a life-time of approximately 3 hours and brought precipitation of 1-5 times 10 to the 8th power tons. Although M gamma CSs developed in the eastern, central and trailing portions of the depression, the large part of the precipitation over Kyushu was brought about by M gamma CSs generated around the trailing portion. These M gamma CSs were generated over the western coast of Kyushu. Under the condition of strong vertical wind shear in the trailing portion, M gamma CSs showed remarkable band structures generated over the western coast of Kyushu. The intense precipitation (maximum 100 mm/hr) in this area was not associated with strong gusts not with temperature fall. The orographic influence of Kyushu on the generation of M gamma CSs and the possible role of symmetric instability in the strong vertical shear flow on the formation of precipitation are were discussed. (Author's abstract)
W89-00416

LIFE CYCLE EFFECTS OF CLOUD CLUSTERS ON THE MOISTURE DISTRIBUTION OVER THE EASTERN ATLANTIC,
Hawaii Univ., Honolulu. Dept. of Meteorology.
Y.-L. Chen.
Journal of the Meteorological Society of Japan JMSJAV, Vol. 66, NO. 2, p 387-391, April 1988. 3 fig, 2 tab, 15 ref.

Descriptors: *Atlantic Ocean, *Clouds, *Rainfall distribution, *Precipitation, Meteorology, Convective precipitation, Mesoscale convection.

Life cycle effects of cloud clusters on the moisture distribution are studied using GATE data. As clusters develop, moisture supply exceeds precipitation, the excess being transported upward by convective clouds and stored in the midlevel outflow divergence region. The fraction of moisture supply going into storage decreases during growth. Total moisture content and moisture supply attain their maxima when the radar echo intensity is strongest. When the upper level is cloudiest, both the moisture supply and the radar echo intensity weaken. The middle level divergence is replaced by convergence that maintains the upper level stratiform clouds. Precipitation exceeds moisture supply and the moisture content is depleted. Depletion of moisture below 600 mb is caused primarily by the drying effect of mesoscale sinking beneath the upper level cloud decks. However, moisture continues to increase in the upper troposphere. As clusters dissipate moisture is depleted throughout the entire troposphere. (Author's abstract)
W89-00417

CHARACTERISTIC FEATURES OF SUPERCOOLED RAINDROPS IN THE MID-WINTER SEASON OF ARCTIC CANADA,
Akita Univ. (Japan). Dept. of Earth Science.
M. Kajikawa, K.-I. Sakurai, and K. Kikuchi.
Journal of the Meteorological Society of Japan JMSJAV, Vol. 66, NO. 2, p 393-398, April 1988. 9 fig, 14 ref.

Descriptors: *Rain, *Arctic zone, *Arctic, *Supercooling, *Precipitation, *Canada, Particle size, Rainfall intensity, Air temperature, Snow, Meteorology.

Supercooled raindrops were observed for several hours at Yellowknife, N.W.T., Canada on January 10, 1986. The characteristics of supercooled raindrops, such as the size distribution and the precipitation intensity, were examined from samples obtained at about 10 or 15 minute intervals. The following main results were obtained: (1) The size distribution of supercooled raindrops was similar to the Marshall-Palmer distribution type; (2) Because a layer of air temperature higher than O Celsius was not detected at Yellowknife, it is impossible that the supercooled raindrops resulted from melting snow crystals. Accordingly, it seems reasonable to conclude that they were formed by the warm rain forming process; and (3) The precipitation intensity, the water content, and the total concentration of supercooled raindrops in general resemble the features of drizzle type rain. (Author's abstract)
W89-00418

SEASONAL AND TEMPORAL CHANGES OF ORGANIC COMPOUNDS IN RAIN AND SNOW,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
For primary bibliographic entry see Field 5B.
W89-00429

RAIN-AEROSOL COUPLING IN URBAN AREA: SCAVENGING RATIO MEASUREMENT AND IDENTIFICATION OF SOME TRANSFER PROCESSES,
Paris-7 Univ. (France). Lab. de Physico-Chimie de l'Atmosphere.
J. L. Jaffrezo, and J. L. Colin.
Atmospheric Environment ATENBP, Vol. 22, No. 5, p 929-935, May 1988. 1 fig, 2 tab, 45 ref.

Descriptors: *Precipitation scavenging, *Path of pollutants, *Water pollution sources, *Aerosols, *Air pollution, *Chemistry of precipitation, Heavy metals, Particle size, Particulate matter, Hygroscopy, Aluminium, Silicon, Iron, Zinc, Magnesium, Chemical analysis.

Coupling between rain and associated aerosol was studied for one year in Paris. Sampling techniques were chosen to describe the interacting phases as precisely as possible: exclusion of dry deposition, separation of successive rain events by an automatic sequential collector and aerosol collection over 6-h periods only. Study of interphase correlations for 82 events revealed three groups of species with distinctly different behavior: insolubles -- Al, Si, Fe; solubles -- SO4(2-), K, Ca, Zn, Mg; and the extreme case of Na and Cl. Variations of the scavenging ratio are in good agreement with the theoretical curve for collection efficiency. Noteworthy is the rise of the experimental curve for sub-micrometerm particles. An interpretation based on the origin and hygroscopy of the species was attempted. Apart from their predictive ability in geochemical assessment, scavenging ratios appear useful for investigating the mechanisms of transfer between aerosols and precipitation. (Author's abstract)
W89-00430

ATMOSPHERIC DEPOSITION OF ARSENIC AND ASSOCIATION WITH ACID PRECIPITATION,
Delaware Univ., Lewes. Coll. of Marine Studies.
For primary bibliographic entry see Field 5B.
W89-00431

SHORT-TERM TRENDS IN SULFATE DEPOSITION AT SELECTED BULK PRECIPITATION STATIONS IN NEW YORK,
For primary bibliographic entry see Field 5B.
W89-00432

COMPARISONS OF RADM AND OSCAR PRECIPITATION CHEMISTRY DATA,
State Univ. of New York at Albany. Atmospheric Sciences Research Center.
For primary bibliographic entry see Field 5B.
W89-00433

RAIN ACIDITY IN STELLENBOSCH,
For primary bibliographic entry see Field 5A.
W89-00454

PREDICTABILITY OF TWO MOISTURE SOURCES IN THE NAMIB DESERT,
Desert Ecological Research Unit, Namibia (South Africa).
R. D. Pietruszka, and M. K. Seely.

South African Journal of Science SAJSAR, Vol. 81, No. 11, p 682-685, November/December 1985. 5 fig, 29 ref.

Descriptors: *Weather forecasting, *Arid lands, *Namib Desert, *Moisture, *Fog, Rainfall, Precipitation, Deserts, Prediction.

Autocorrelation analysis was used to examine the temporal predictability of two moisture sources in the Namib Desert, fog-water precipitation and rainfall. Although longitudinal gradients in the predictability of both sources were apparent, fog was more predictable than rainfall. Because of the greater predictability and lower variability of fog-water precipitation, it is a more reliable moisture source. This may have been a major factor in the evolution of the unusual biota of this desert. (Author's abstract)
W89-00455

SUMMER OF 1987 IN NORTH-EAST ENGLAND,
Sunderland Polytechnic (England). Dept. of Geography.
D. A. Wheeler.
Weather WTHRAL, Vol. 43, No. 5, p 187-192, May 1988. 4 fig, 4 tab, 2 ref.

Descriptors: *England, *Meteorology, *Weather patterns, *Weather, Rainfall, Drought, Rainfall distribution, Precipitation.

The poor weather of the summer of 1987 has been remarked upon by meteorologist and layman alike, but upon close inspection one finds that the indifferent weather was not equally apportioned about the country. The August edition of the Climatological Observer's Link Newsletter drew attention to the dryness of the summer (the 'summer' here being taken to be the three months of June, July, and August). The season's rainfall total at Yatton in Avon, for example, was only 72% of the average, an experience shared by many south-western districts. Much, but not all, of the poor weather was experienced over the eastern half of the country. That it therefore embraced London and the Home Counties goes far in explaining its wide publicity. Conditions experienced in north-east England are described. Data are taken from the nine cooperating stations that supply the Newcastle Weather Center, supplemented by the writer's own materials gathered at Sunderland. (Lantz-PTT)
W89-00463

54 HOURS OF CONTINUOUS POST-FRONTAL PRECIPITATION NORTH OF THE ALPINE MOUNTAIN BARRIER, 22-25 AUGUST 1975,
W. S. Pike.
Weather WTHRAL, Vol. 43, No. 7, p 246-254, July 1988. 7 fig, 5 ref.

Descriptors: *Canada, *Precipitation, *Weather, *Post-frontal precipitation, *Vancouver, Vitznau, Air entrainment, Orography.

Post-frontal precipitation (PFP) lasting 48 hr or more occurred just once at Vancouver International Airport during the 30-yr study period, 1953-83. Although it is impossible to say whether this duration of event has a return period closer to 10 yr than 100 yr, it may still be considered an infrequent if not rare occurrence, even at one particular favored location. The cases of PFP lasting 48 hr or more at: (1) Vancouver on 14-16 May 1959 and (2) Vitznau on Lake Luzerne, Switzerland, over 22-25 August 1975 had several common factors, which include: (1) a 500 mbar trough which was extending longitudinally approaching from the west, prior to forming an upper 'cut-off low' situated south of the affected area during the event, with a 'frontogenic col' area of light winds nearby the PFP; (2) Low-level post-frontal airflow-blocking by the local topography up to at least 800 mbar; (3) Low-level flow-blocking which is considered to be an early prerequisite of lee cyclogenesis, which occurs here in both cases southeast of the PFP affected area and effectively slows frontal clearance; (4) Large thermal contrast of airmasses. The incoming polar maritime airflow was 8-10 deg Celcius cooler at lower levels than the continental air it replaced, with an active frontal zone between the two; (5) A 'hovering', quasi-stationary frontal zone coincides with a near-180 degrees 'counter-balancing' wind-shear layer around mountain barrier-top height for some hours, causing continuing PFP up to 200 km from the crestline, windward of the mountains. (Lantz-PTT)
W89-00464

PRINCIPAL COMPONENT ANALYSIS OF PRECIPITATION IN THE ADRIATIC-PANNONIAN AREA OF YUGOSLAVIA,
Hydrometeorological Inst. of Croatia, Zagreb (Yugoslavia).
K. Pandzic.
Journal of Climatology JOUCD2, Vol. 8, No. 4, p 357-370, July-August 1988. 9 fig, 2 tab, 15 ref.

Descriptors: *Precipitation, *Cyclonic precipitation, *Principal component analysis, *Adriatic Sea, *Yugoslavia, Areal precipitation, Meteorological data collection, Pannonian lowland, Graphical analysis, Numerical analysis, Cyclones, Weather patterns.

Some characteristics of the precipitation pattern were established for an area from the Adriatic Sea to the Pannonian lowland (territory of Croatia). The data of monthly precipitation amounts for the 20-year period (1961-1980) from 108 meteorological stations were used. The first four principal components (PCs), which describe 79.4% of the total precipitation field variance, were considered. It was shown, graphically and numerically, that the first PC is related to the frequency of cyclones on van Beber's 'continental' (Pannonian) cyclone paths IVb, Vb, and Vc, the second one is related to their frequency on the 'maritime' (Mediterranean) paths Vd, Vd1, and Ve, the third to the anticyclonic and non-gradient weather type, and the fourth is related to the frequency of cold fronts crossing Yugoslavian territory. Using the loadings of the PCs, four homogeneous precipitation sectors were determined and compared to those obtained by Koeppen's 'homogeneous precipitation region' scheme. Finally, some details of the annual pattern of precipitation for these sectors are discussed. (Author's abstract)
W89-00472

REGIONALIZATION OF DAILY RAINFALL IN KENYA BY MEANS OF COMMON FACTOR ANALYSIS,
Lund Univ. (Sweden). Dept. of Physical Geography.
L. Barring.
Journal of Climatology JOUCD2, Vol. 8, No. 4, p 371-389, July-August 1988. 10 fig, 4 tab, 51 ref.

Descriptors: *Precipitation, *Factor analysis, *Rainfall distribution, *Statistical analysis, *Kenya, East Africa, Data interpretation, Graphical analysis, Model studies, Regionalization, Physiographic provinces, Orography, Climatology, Weather data collections, Meteorological data collection.

Daily rainfall data from 73 stations distributed throughout Kenya were subjected to maximum-likelihood factor analysis. Data for the period January 1971 to December 1985 were used. A brief analysis of data quality and representativity and the problem of missing data are included. The data were transformed by natural logarithms. Scree and LEV plots together with the Kendall/North criterion for eigenvalue separation indicated break points at 5, 11, and 15 factors. The 11-factor model was judged as being the most parsimonious, for both statistical and climatological reasons. It explained 38% of the total variance. The general features of the regionalization are found to be reasonably consistent with other studies. The major regions (the coast, the Highlands, the Lake Victoria area, and the dry northern/eastern areas) appear in this regionalization but are divided into several subregions. It can be concluded that this subdivision is partly linked to the physiographic regions and orographic influence. In addition, possible links to regional circulation patterns are discussed. (Author's abstract)
W89-00473

EL NINO AND ITS EFFECT ON PRECIPITATION IN ARIZONA AND WESTERN NEW MEXICO,
Arizona Univ., Tucson. Inst. of Atmospheric Physics.
E. R. Andrade, and W. D. Sellers.
Journal of Climatology JOUCD2, Vol. 8, No. 4, p 403-410, July-August 1988. 1 fig, 5 tab, 25 ref. NSF Grant ATM-8203509.

Descriptors: *Precipitation, *Rainfall distribution, *El Nino, *Arizona, *New Mexico, *Weather patterns, Statistical analysis, Correlation analysis, Southern Oscillation index, Climatology.

The effect of El Nino on seasonal and annual precipitation was examined at 26 locations for an 86-year period from 1900 to 1985. Each year was classified as either a non-El Nino year (51 of the 86 years) or an El Nino year (35 of the years), with the El Ninos designated as being very weak (4 years), weak (8 years), moderate (12 years), or strong (11 years). Using the Mann-Whitney U-test for the 19 stations in Arizona, it was found that, in the spring (March-May) and in the autumn (September-November), there is a positive relationship between precipitation in Arizona and both moderate and strong El Ninos. These results were verified by correlating seasonal and annual precipitation for the complete 26-station network with the Southern Oscillation index (normalized pressure difference between Tahiti, French Polynesia and Darwin, Australia). The results indicate that El Nino's impact in this region is most pronounced in the normally dry spring and autumn. It is suggested that precipitation in both seasons is enhanced by teh presence of unusually warm water off the California coast and the west coast of Mexico. This water provides the energy necessary for the development of strong west coast troughs; it also weakens the tradewind inversion and allows moist air to penetrate in larger quantities than normal into the Southwest. (Shidler-PTT)
W89-00474

MULTIDIMENSIONAL MODELING OF CUMULATIVE RAINFALL: PARAMETER ESTIMATION AND MODEL ADEQUACY THROUGH A CONTINUUM OF SCALES,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
S. Islam, R. L. Bras, and I. Rodriguez-Iturbe.
Water Resources Research WRERAO, Vol. 24, No. 7, p 985-992, July 1988. 10 fig, 5 tab, 11 ref. NSF Grant 8611458-ATM and National Weather Service Grant PNGD NA 86AA-D-HY 123.

Descriptors: *Hydrologic models, *Mathematical models, *Rainfall, *Cumulative rainfall, Multidimensional modeling, Statistics, Spatial distribution, Temporal distribution, Performance evaluation, Time series analysis, Walnut Gulch, Arizona, Ephemiral streams.

The multidimensional representation of the cumulative rainfall process is presented and a closed-form expression for the mean and space-time covariance functions is derived. A parameter estimation procedure is developed. Sensitivity analysis provides useful information for devising the parameter estimation strategy. The cumulative rainfall model is applied to 8 yr (southeastern Arizona) of digitized rain gage data from the Walnut Gulch Experimental Watershed. The most useful feature of the model is its self-consistency, implying that even after using information from a given limited set of data it still leads to realistic parameters which reproduce historical statistics at several levels of time and space scales. (See also W89-00724) (Author's abstract)
W89-00706

CHEMICAL-HYDROLOGIC INTERACTIONS IN THE NEAR-STREAM ZONE,
Agricultural Research Service, University Park, PA. Northeast Watershed Research Center.
For primary bibliographic entry see Field 2E.
W89-00717

EVALUATION OF A HOMOGENEOUS POINT PROCESS DESCRIPTION OF ARIZONA THUNDERSTORM RAINFALL,
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab.
B. L. Jacobs, I. Rodriguez-Iturbe, and P. S. Eagleson.
Water Resources Research WRERAO, Vol. 24, No. 7, p 1174-1186, July 1988. 9 fig, 3 tab, 16 ref. NSF Grant ATM-8420781.

Descriptors: *Hydrologic models, *Stochastic models, *Thunderstorms, *Storms, *Rainfall, Rain gages, Point process model, Summer, Walnut Gulch, Ephemeral streams, Arizona.

Rain gage observations of storm events at Walnut Gulch, Arizona, are used to evaluate the Rodriguez-Iturbe and Eagleson stochastic, point process model of storm events. Five hundred fifty-eight summer storm events are identified over the years 1970-1977 and the parameters of the model estimated by the method of moments for each event as well as for the entire ensemble of events. The model is evaluated by comparing the observed correlation function of the temporally averaged rainfall process to its theoretical analog. (See also W89-00706) (Author's abstract)
W89-00724

MESOSCALE SPIRAL VORTEX EMBEDDED WITHIN A LAKE MICHIGAN SNOW SQUALL BAND: HIGH RESOLUTION SATELLITE OBSERVATIONS AND NUMERICAL MODEL SIMULATIONS,
San Francisco State Univ., CA.
S. R. Pease, W. A. Lyons, C. S. Keen, and M. Hjelmfelt.
Monthly Weather Review MRWEAB, Vol. 116, No. 6, p 1374-1380, June 1988. 6 fig, 33 ref.

Descriptors: *Snow, *Squalls, *Weather patterns, *Lake Michigan, *Satellite technology, *Model studies, Simulation, Great Lakes, Clouds, Temperature, Wind, Vortices, Numerical analysis, Heating.

It is known that Great Lakes snow-squall convection occurs in a variety of different modes depending on various factors such as air/water temperature contrast, boundary-layer wind shear, and geostrophic wind direction. An exceptional and often-neglected source of data for mesoscale cloud studies is the ultrahigh-resolution multispectral data produced by Landsat satellites. On 19 October 1972, a clearly-defined spiral vortex was noted in a Landsat-1 image near the southern end of Lake Michigan during an exceptionally-early cold-air outbreak over a still-very-warm lake. In a numerical simulation using a 3-D Eulerian hydrostatic primitive-equation mesoscale model (8 km grid, 36 x 46 x 11), with an initially-uniform wind field, a definite analog to the observed vortex was generated. This suggests that intense surface heating can be a principal cause in the development of a low-level mesoscale vortex. (Author's abstract)
W89-00748

RAIN MEASUREMENT BY RAINGAGE-RADAR COMBINATION: A GEOSTATISTICAL APPROACH,
Institut de Mecanique de Grenoble, Saint-Martin d'Heres (France).
For primary bibliographic entry see Field 7B.
W89-00761

CHARGE INDUCED ON A CONDUCTING CYLINDER BY A POINT CHARGE AND ITS APPLICATION TO THE MEASUREMENT OF CHARGE ON PRECIPITATION,
National Center for Atmospheric Research, Boulder, CO.
For primary bibliographic entry see Field 7B.
W89-00762

THEORETICAL EVALUATION OF WATER OLIGOMER POPULATIONS IN THE EARTH'S ATMOSPHERE,
Hokkaido Univ., Sapporo (Japan). Dept. of Chemistry.
Z. Slanina.
Journal of Atmospheric Chemistry JATCE2, Vol. 6, No. 3, p 185-190, April 1988. 1 fig, 1 tab, 29 ref.

Descriptors: *Atmospheric water, *Nucleation, *Water vapor, *Humidity, Water properties, Electrochemical properties, Atmosphere.

Atmospheric water vapor is treated as an equilibrium mixture of gas-phase water clusters, (H20)sub i, using recent precise quantum-chemical data on these species. Within a typical atmospheric temperature/humidity profile, the cluster populations in the Earth's atmosphere decrease with increasing height, being of the order of magnitude of 0.1 microgram/cu m and 0.1 ug/cu m for the water dimer and trimer, respectively, in the atmospheric pressure region of 700-800 mb. (Author's abstract)
W89-00763

LIQUID CLOUDWATER COLLECTION USING MODIFIED MOHNEN SLOTTED RODS,
Colorado Coll., Colorado Springs. Dept. of Chemistry.
For primary bibliographic entry see Field 7B.
W89-00764

WET DEPOSITION OF AMMONIUM IN EUROPE,
Utrecht Rijksuniversiteit (Netherlands). Inst. voor Meteorologie en Oceanografie.
E. Buijsman, and J. Erisman.
Journal of Atmospheric Chemistry JATCE2, Vol. 6, No. 3, p 265-280, April 1988. 3 fig, 3 tab, 43 ref.

Descriptors: *Ammonium, *Chemistry of precipitation, *Deposition, *Air pollution, Atmospheric water, Water analysis, Europe, Sampling, Chemical analysis.

Ammonium concentration data in precipitation have been compiled to derive a concentration and deposition field for ammonium in Europe. Measurements referring to a total number of 218 measuring sites have been considered. Because of changes in the ammonium concentrations due to the use of improper sampling procedures, a correction procedure is proposed. This makes allowance for the type of sampler used, the length of the sampling period, and whether or not light-protected sample bottles are used. Dependent on the specific sampling procedure used, correction factors range from 0.75 to 1.20. According to our calculations, the total wet deposition flux of ammonium in Europe in the early 1980s amounts to 2.4 Mt NH4(+)/y. However, for some parts of Europe, the flux cannot be estimated very reliably because of the low number or even the absence of measuring sites. Compared to earlier estimates for around 1960, the ammonium wet deposition flux has increased by approximately 25% during the period 1960-1980. (Author's abstract)
W89-00765

CLIMATE OF THE ESTUARY AND FIRTH OF CLYDE,
University of Strathclyde, Glasgow (Scotland). Dept. of Geography.
For primary bibliographic entry see Field 2L.
W89-00800

FRESH WATER INFLOWS TO THE FIRTH OF CLYDE,
Clyde River Purification Board, East Kilbride (Scotland).
For primary bibliographic entry see Field 2L.
W89-00801

IDENTIFICATION OF RAINFALL TYPE FROM WEATHER RADAR DATA,
Birmingham Univ. (England). Dept. of Civil Engineering.
G. W. Shepherd, I. D. Cluckie, C. G. Collier, S. Yu, and P. K. James.
Meteorological Magazine MTMGA5, Vol. 117, No. 1391, p 180-186, June 1988. 4 fig, 15 ref.

Descriptors: *Weather forecasting, *Radar, *Rainfall, *Remote sensing, Meteorological data collection, Weather data collections, Mathematical analysis.

A method of identifying rainfall type (frontal or convective) using data from a weather radar uses pattern-recognition information, derived from space-time correlation surfaces, as local rainfall type indicators. The rectangular ratio of space-time correlation surfaces shows variations that are a function of the shape of the data contours and therefore provides a means of identifying storm type for the data window analyzed. More detailed investigations is needed to identify the most appropriate size for the data windows used. (Alexander-PTT)
W89-00842

MODEL OUTPUT STATISTICS FORECASTS: THREE YEARS OF OPERATIONAL EXPERIENCE IN THE NETHERLANDS,
Royal Netherlands Meteorological Inst., De Bilt.
C. Lemcke, and S. Kruizinga.
Monthly Weather Review MRWEAB, Vol. 116, No. 5, p 1077-1090, May 1988. 15 fig, 16 tab, 27 ref, append.

Descriptors: *Netherlands, *Weather forecasting, *Model studies, Meteorological data collection, Weather data collections, Climatology, Rainfall, Thunderstorms, Statistical methods.

In the Netherlands, one to five day Model Output Statistics (MOS) forecasts have been used operationally since November 1983. The weather elements predicted are the probability of precipitation, the conditional probability of frozen precipitation, the probability of thunderstorms, the sunshine, maximum and minimum temperature and the maximum wind speed. For the development of the guidance system, two years of ECMWF data (December 1980-November 1982) were used, while a third year was available as a test period. The period December 1983-November 1986 has been used for verification. Operational forecasters have used the MOS forecast for the preparation of their final forecasts. The results of the MOS forecasts and of subjective forecasts are presented and compared. From this comparison it appears that the forecasters have higher skill scores only for Days 1 and 2; for Days 3, 4 and 5 the differences are, in general, small. (Author's abstract)
W89-00843

COMPARISON OF HIGH-ALTITUDE REMOTE AIRCRAFT MEASUREMENTS WITH THE RADAR STRUCTURE OF AN OKLAHOMA THUNDERSTORM: IMPLICATIONS FOR PRECIPITATION ESTIMATION FROM SPACE,
National Aeronautics and Space Administration, Greenbelt, MD. Lab. for Atmospheric Sciences.
For primary bibliographic entry see Field 7B.
W89-00844

EXPERIMENTAL MARVIN WINDSHIELD EFFECTS ON PRECIPITATION RECORDS IN LEADVILLE, COLORADO,
Geological Survey, Lakewood, CO.
For primary bibliographic entry see Field 7B.
W89-00876

ESTIMATION OF CATCHMENT RAINFALL UNCERTAINTY AND ITS INFLUENCE ON RUNOFF PREDICTION,
Technical Univ. of Denmark, Lyngby.
For primary bibliographic entry see Field 2A.
W89-00892

SPATIAL VARIABILITY OF SHORT-TERM RAINFALL AMOUNTS IN A COASTAL MOUNTAIN REGION OF SOUTHERN AFRICA,
Rhodes Univ., Grahamstown (South Africa). Dept. of Geography.
D. A. Hughes, and A. Wright.

Water SA, Vol. 14, No. 3, p 131-138, July 1988. 6 fig, 2 tab, 19 ref.

Descriptors: *Spatial distribution, *Rainfall, *South Africa, *Precipitation, Mountains, Rainstorms, Seasonal variation, Weather patterns.

Spatial variations in short-term rainfall in the southern Cape coastal mountain region of southern Africa are discussed. Analyses of storm rainfall totals and storm profiles reveal patterns of variability that are similar to those suggested by an earlier analysis of mean annual data in the same region. The patterns of spatial variation appear to be more consistent in winter when a lower diversity of weather patterns is responsible for generating rainfall. A pattern of local rain shadows, in the lee of higher relief areas relative to rain bearing winds, is superimposed upon a general increase in storm rainfall with altitude. For nine continuously recording rainfall stations, storm profiles exhibit a high degree of similarity in timing and shape but not rainfall depth. This feature suggests that the spatial variation of temporal intensity occurs on a relatively large scale. The data analyzed did not suggest any consistent differences between station profiles that could be attributed to differences in weather patterns. (Author's abstract)
W89-00932

LANDSCAPE AND RAINFALL INDICES FOR PREDICTION OF STREAMFLOW SIMILARITIES IN THE HUNTER VALLEY, AUSTRALIA,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Water Resources.
For primary bibliographic entry see Field 2E.
W89-00972

FOG DRIP AS A SOURCE OF GROUNDWATER RECHARGE IN NORTHERN KENYA,
California Univ., Davis. Dept. of Geology.
For primary bibliographic entry see Field 2F.
W89-00984

MACROHYDROLOGY: THE NEW CHALLENGE FOR PROCESS HYDROLOGY,
National Aeronautics and Space Administration, Greenbelt, MD. Hydrological Sciences Branch.
For primary bibliographic entry see Field 2A.
W89-01012

SPATIAL AND TEMPORAL SCALES IN RAINFALL ANALYSIS SOME ASPECTS AND FUTURE PERSPECTIVES,
Lund Univ. (Sweden). Dept. of Water Resources Engineering.
R. Berndtsson, and J. Niemczynowicz.
Journal of Hydrology JHYDA7, Vol. 100, No. 1/3, p 293-313, July 30, 1988. 7 fig, 128 ref.

Descriptors: *Model studies, *Precipitation, *Rainfall, *Literature reviews, Spatial variation, Mathematical models, Rainfall distribution, Runoff, Urbanization, Industrialization, Hydrologic models.

Aspects of spatial and temporal rainfall variability and rainfall analysis in relation to some water management problems are surveyed and discussed. It is concluded that relevant modeling of hydrological processes in which the rainfall is a driving force is vital with respect to possibilities of finding solutions to increasing environmental problems following urbanization and industrialization. However, modern computer methods and our knowledge of the spatial and dynamic properties of rainfall fields are seldom used in practical engineering applications. This causes errors and uncertainties in the calculated output. Bridging the gaps between researchers and engineers may overcome some of these problems. It is also argued that experimental studies in a variety of climates and physiographical conditions using an interdisciplinary approach are needed in order to further investigate the scale and dynamics of spatial rainfall variability. (Author's abstract)
W89-01021

HILLSLOPE RUNOFF PROCESSES AND MODELS,
Leeds Univ. (England). School of Geography.
For primary bibliographic entry see Field 2A.
W89-01022

RAINFALL-RUNOFF MODELING: PAST, PRESENT AND FUTURE,
Bologna Univ. (Italy).
For primary bibliographic entry see Field 2A.
W89-01023

INFLUENCE OF ALTITUDE ON RAINFALL COMPOSITION AT GREAT DUN FELL,
Institute of Terrestrial Ecology, Edinburgh (Scotland).
For primary bibliographic entry see Field 5B.
W89-01146

INFLUENCE OF ALTITUDE ON WET DEPOSITION: COMPARISON BETWEEN FIELD MEASUREMENTS AT GREAT DUN FELL AND THE PREDICTIONS OF A SEEDER-FEEDER MODEL,
University of Manchester Inst. of Science and Technology (England). Dept. of Pure and Applied Physics.
For primary bibliographic entry see Field 5B.
W89-01147

OCCURRENCE AND DISTRIBUTION OF TRACE ORGANIC COMPOUNDS IN BERMUDA PRECIPITATION,
Bermuda Biological Station for Research, Ferry Reach.
For primary bibliographic entry see Field 5B.
W89-01148

DISSOLUTION OF TRACE METALS FROM PARTICLES OF INDUSTRIAL ORIGIN AND ITS INFLUENCE ON THE COMPOSITION OF RAINWATER,
Leeds Univ. (England). Dept. of Fuel and Energy.
For primary bibliographic entry see Field 5B.
W89-01149

AEROSOL AND HYDROMETEOR CONCENTRATIONS AND THEIR CHEMICAL COMPOSITION DURING WINTER PRECIPITATION ALONG A MOUNTAIN SLOPE: I. TEMPORAL EVOLUTION OF THE AEROSOL, MICROPHYSICAL AND METEOROLOGICAL CONDITIONS,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Atmospheric Physics Lab.
T. Schumann, B. Zinder, and A. Waldvogel.
Atmospheric Environment ATENBP, Vol. 22, No. 7 p 1443-1459, July 1988. 8 fig, 4 tab, 26 ref.

Descriptors: *Orographic precipitation, *Air pollution, *Acid rain, *Aerosols, *Chemistry of precipitation, Mountains, Particle size, *Micrometeorology, Seasonal variation, Precipitation, Slopes, Precipitation scavenging, Wet deposition, Field tests, Rain, Snow, Hydrometeorology, Air masses, Nucleation, Clouds, Rainfall rate.

A field experiment studying aerosol scavenging in winter precipitation is presented. Events of frontal precipitation (rain and snow) are investigated. Emphasis is put on the temporal evolution of aerosol and hydrometeor size distributions, and mesometeorological conditions. The simultaneous observation of the microphysics (for scavenging processes) and the mesometeorology (for air-mass changes) is crucial for the quantitative understanding of pollutant concentrations in air and precipitation. Our studies suggest that microphysical conditions govern pollutant levels during the initial stage (approximately the first mm) of precipitation, while effects from air-mass changes dominate at later time intervals. Regarding scavenging, nucleation scavenging has been found to be the major removal mechanism for particles with diameter >0.25 microns (mass reduction of >95%), whereas below-cloud scavenging is much less effective (10% reduction of large particles, 30% of giant particles). Scavenging coefficients as a function of aerosol diameter have been determined for rain in below-cloud conditions. It is recommended that scavenging coefficients should be calculated and expressed in per-millimeter, rather than per-second, units. Values determined in an individual rain event show a very large scatter of more than a factor of 10, a manifestation of the complexity of scavenging mechanisms. Values for large particles observed in this study range from 0.0003 to 0.000005 per s, or 0.05-20 per mm. A dependence of the scavenging coefficient on rainfall rate was found. (Author's abstract)
W89-01150

ACIDIC DEPOSITION DISTRIBUTION AND EPISODE STATISTICS FROM THE MAP3S NETWORK DATABASE,
Battelle Pacific Northwest Labs., Richland, WA. Atmospheric Sciences Dept.
For primary bibliographic entry see Field 5B.
W89-01151

WET-ONLY PRECIPITATION STUDY IN A MEDITERRANEAN SITE, PATRAS, GREECE,
Patras Univ. (Greece). Dept. of Chemistry.
S. Glavas.
Atmospheric Environment ATENBP, Vol. 22, No. 7 p 1505-1507, July 1988. 2 fig, 1 tab, 12 ref.

Descriptors: *Precipitation, *Acid rain, *Mediterranean Sea, *Greece, Chemistry of precipitation, Hydrogen ion concentration, Alkalinity, Air masses, Air pollution.

This study was conducted from October 1985 to April 1986. Very-high pH variations were recorded, ranging from pH 4.12 to 8.76, indicating high variability in the acid sources and in neutralization processes. Chemical analysis was performed for hydrogen, sulfate, nitrate, chloride, calcium, magnesium, and ammonium ions to evaluate the contribution of each ion to the acidity and alkalinity of the precipitation. Air masses originating in northwestern Europe correlate very well with the acidic episodes, whereas those from northern Africa have precipitation with pH >5. (Author's abstract)
W89-01152

IMPACT OF RAINFALL AND SOIL HYDRAULIC PROPERTY INFORMATION ON RUNOFF PREDICTIONS AT THE HILLSLOPE SCALE,
Hawaii Univ. at Manoa, Honolulu. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 2E.
W89-01246

TEMPORAL VARIABILITY IN SPATIAL CORRELATION OF DAILY RAINFALL,
Lund Univ. (Sweden). Dept. of Water Resources Engineering.
R. Berndtsson.
Water Resources Research WRERAO, Vol. 24, No. 9, p 1511-1517, September 1988. 11 fig, 1 tab, 24 ref.

Descriptors: *Rainfall, *Rainfall distribution, *Correlation analysis, *Tunisia, Temporal distribution, Seasonal distribution, Spatial distribution, Weather data collections, Statistical analysis, Coasts, Topography, Weather patterns.

Composite correlation fields based on a 5-year record of daily rainfall at 67 stations throughout Tunisia were used to investigate spatial and temporal properties of rainfall fields. The composite correlation fields had in general banded or elliptical patterns and with the elongations generally along the coastline or the topographical ridges. The banded patterns occurred usually during the rainy season, and the elliptical patterns occurred toward the summer or early autumn. The ratio of width to length of the elongated correlation fields varied in general between 0.1 and 0.4. The composite correlation fields defined as the areas within the 0.7 correlation isoline were usually less than about 8000 square km. The mean monthly rainfall was moderately correlated with the size of the compos-

ite correlation fields. The major orientation of the coastline seemed to be a more important factor for rainfall generation than were local irregularities in the coastal orientation and local topographical differences. (Author's abstract)
W89-01247

DETERMINING MICROWAVE BRIGHTNESS TEMPERATURES FROM PRECIPITATING HORIZONTALLY FINITE AND VERTICALLY STRUCTURED CLOUDS,
Wisconsin Univ.-Madison. Space Science and Engineering Center.
For primary bibliographic entry see Field 7B.
W89-01263

WINTER CLOUD WATER AND AIR COMPOSITION IN CENTRAL ONTARIO,
Atmospheric Environment Service, Downsview (Ontario).
For primary bibliographic entry see Field 5C.
W89-01265

2C. Snow, Ice, and Frost

FILTERLESS REVETMENT OF THE SLOPES OF DIKES AT PUMPED-STORAGE STATION RESERVOIRS,
For primary bibliographic entry see Field 8A.
W89-00058

WORKS OF S. V. SHESTOPEROV ON FROST RESISTANCE OF HYDROTECHNICAL CONCRETE,
For primary bibliographic entry see Field 8F.
W89-00061

WINTER DIURNAL TRENDS OF SIERRA NEVADA SUPERCOOLED LIQUID WATER AND PRECIPITATION,
Electronic Techniques, Inc., Auburn, CA.
For primary bibliographic entry see Field 3B.
W89-00089

PERSISTENT EFFECTS OF CLOUD SEEDING WITH SILVER IODIDE,
Commonwealth Scientific and Industrial Research Organization, Aspendale (Australia). Div. of Atmospheric Research.
For primary bibliographic entry see Field 3B.
W89-00091

DETERMINATION OF NITRATE AT THE NG/G LEVEL IN ANTARCTIC SNOW SAMPLES WITH ION CHROMATOGRAPHY AND ISOTOPE DILUTION MASS SPECTROMETRY,
Regensburg Univ. (Germany, F.R.). Inst. fuer Anorganische Chemie.
For primary bibliographic entry see Field 5A.
W89-00269

DETERMINATION OF HEAVY METALS AT THE PG/G LEVEL IN ANTARCTIC SNOW WITH DPASV AND IDMS,
Regensburg Univ. (Germany, F.R.). Inst. fuer Anorganische Chemie.
For primary bibliographic entry see Field 5A.
W89-00270

CREEP OF ICE MEASURED WITH THE PRESSUREMETER,
Atomic Energy of Canada Ltd., Pinawa (Manitoba).
B. H. Kjartanson, D. H. Shields, L. Domaschuk, and C. S. Man.
Canadian Geotechnical Journal CGJOAH, Vol. 25, No. 2, p 250-261, May 1988. 23 fig, 1 tab, 27 ref.

Descriptors: *Cryology, *Glaciology, *Rheology, *Ice, *Creep, *Pressuremeter, Measuring instruments, Data acquisition, Ice pressure, Field tests, Compression tests, Glaciers.

The pressuremeter has the potential to measure the creep parameters of ice in the field, in ice at its natural temperature and natural stress environment, and in ice that has not been disturbed by sampling and handling. To prove that the pressuremeter can in fact be used to measure creep properties, a series of pressuremeter tests were run in the laboratory in polycrystalline ice at -2 C. It was found that: (1) the particular pressuremeter used maintained an ability to measure creep deformation accurately over a period of 7 weeks; (2) the test results agree for the most part with the findings of other investigators who have used uniaxial compression tests; and (3) the pressuremeter brings into question at least one of the more common assumptions regarding primary creep. (Author's abstract)
W89-00387

SUBSOIL INVESTIGATION OF ICE LENSING AT THE CALGARY, CANADA, FROST HEAVE TEST FACILITY,
L.E.C. Engineering, Calgary (Alberta).
L. E. Carlson, and J. F. Nixon.
Canadian Geotechnical Journal CGJOAH, Vol. 25, No. 2, p 307-319, May 1988. 15 fig, 8 ref.

Descriptors: *Frozen ground, *Soil water, *Ice lenses, *Frost heaving, *Pipelines, Frost, Heaving, Field tests, Thawing, Model studies, Calgary, Insulation, Simulation, Spatial distribution, Cold regions, Frost protection.

Several frost heave mitigation modes were studied at the Calgary, Canada, chilled pipeline frost heave test facility. These included deeper burial (to increase the pressure on the frost front below the pipe) and replacement of the silty soil around the pipe with gravel for a noninsulated pipe. Frost heave at the deep-burial section and at the gravel section was less than the heave at a control section. Other pipe sections tested the effects of insulation of the pipe on the long-term frost heave, as well as the effects of replacing the silt around an insulated pipe with gravel. Summer thawing of the frost bulb around the insulated pipe results in seasonal thaw settlement of the pipe, thus reducing the long-term pipe heave, at least for the warmer ground temperature environment at the Calgary facility. Thermal simulations of the frost bulb growth and predictions of frost heave using the segregation potential model agree well with the observations. Recent excavation of two frost bulbs in silty soil led to field observations of the interior of the frost bulbs, and subsequent laboratory analysis of frost bulb samples. Ice distribution was logged and photographed following excavation of each frost bulb. (Author's abstract)
W89-00389

RELATIONSHIP BETWEEN DELTA-D AND DELTA-18-O VALUES OF FALLING SNOW PARTICLES FROM A SEPARATE CLOUD,
Nagoya Univ. (Japan). Water Research Inst.
A. Sugimoto, K. Higuchi, and M. Kusakabe.
Tellus TELLAL, Vol. 40B, No. 3, p 205-213, June 1988. 4 fig, 3 tab, 21 ref.

Descriptors: *Snow, *Clouds, *Deuterium, *Oxygen isotopes, Precipitation, Water vapor, Snow crystals, Japan, Isotope studies, Sublimation.

The relationship between delta-D and delta-18-O values (per mille deviation from SNOW) was investigated on falling snow particles from a separate convective cloud collected at 2 stations along a moving cloud trajectory. Observations were made in 1983 in Hokuriku, Japan and in 1985 and 1986 in Hokkaido, Japan. The delta-D and delta-18-O values of snow particles from a separate cloud were linearly related. The values of deuterium excess of observed delta-D-delta-18-O lines were much greater than 10 and differed with each case, while the slope was 8.5-9.6 in 7 or 9 cases. Such observational results indicated that falling snow particles observed at both stations were produced in a cloud consisting of the air parcels containing initial water vapor having the same isotopic composition and that there was a possibility of kinetic effect in the sublimation process during growth of snow crystals. (Author's abstract)
W89-00406

SEASONAL AND TEMPORAL CHANGES OF ORGANIC COMPOUNDS IN RAIN AND SNOW,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
For primary bibliographic entry see Field 5B.
W89-00429

PROGRESS IN DEVELOPING AN OPERATIONAL SNOWMELT-RUNOFF FORECAST MODEL WITH REMOTE SENSING INPUT,
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
For primary bibliographic entry see Field 2A.
W89-00891

CAPACITY OF ICE-COVERED CANALS,
For primary bibliographic entry see Field 8B.
W89-01177

PREDICTION OF SNOWMELT RATES IN A DECIDUOUS FOREST,
Toronto Univ. (Ontario). Dept. of Geography.
A. G. Price.
Journal of Hydrology JHYDA7, Vol. 101, No. 1-4, p 145-157, June 30, 1988. 3 fig, 3 tab, 9 ref.

Descriptors: *Forest hydrology, *Water yield forecasting, *Snowmelt, *Mathematical models, *Deciduous forests, Solar radiation, Energy transfer, Multivariate analysis, Air temperature.

A model is presented for the prediction of the energy available for the melting of snow in a deciduous forest. The turbulent exchanges sensible and latent heat can be estimated using physically based equations, but are small at the forest floor, accounting typically for less than 10% of daily melt totals, largely because of the much reduced wind speed within the forest. Net allwave radiative energy flux density alone is a good predictor of snowmelt rates. Physical modelling of net allwave radiative energy flux density is not operationally possible, and the simple regression of the net allwave radiative energy flux density on solar energy flux, a technique used with success in some circumstances, is shown to be inappropriate in a forest during snowmelt. A multivariate model using two commonly available variables--solar energy flux and air temperature in the forest--explains over three quarters of the variance of the net allwave radiative energy flux density. (Author's abstract)
W89-01203

VERTICALLY INTEGRATED SNOW/ICE MODEL OVER LAND/SEA FOR CLIMATE MODELS: 1. DEVELOPMENT,
Tel-Aviv Univ. (Israel). Dept. of Geophysics and Planetary Sciences.
B. U. Neeman, J. H. Joseph, and G. Ohring.
Journal of Geophysical Research (D) JGRDE3, Vol. 93, No. 4, p 3663-3675, April 29, 1988. 10 fig, 2 tab, 25 ref, append.

Descriptors: *Snow, *Ice, *Climatology, *Model studies, *Sea ice, Climate models, Precipitation, Mathematical models.

Sea ice/snow and land snow models were developed using a vertically integrated formulation (VIF). The VIF model has the capability of simulating the nonlinear effects of heat storage and transfer through the layers of snow and ice, which are felt particularly in spring and fall, yet this is achieved without resorting to the addition of layers to the numerical scheme. For comparison, a stable multilayer model is developed and tested. It was demonstrated that the VIF shares the accuracy of the multilayer formulation, and at the same time benefits from computational flexibility typical of linear formulations. The validity of the VIF assumptions and their parameter dependence were analyzed using an analytically solvable example. It is suggested that the VIF model may be specifically suitable for the implementation in a variety of climate models and general circulation models. A simple parameterization is applied to include sea-

sonal and latitudinal changes in the heat flux from the mixed layer to the ice layer. This flux, though small in magnitude on an annual and latitudinal average, has an important influence on the ice thickness and its seasonal cycle and was taken as a constant in previous sea ice modeling. Latitudinal dynamical sea ice transport is also included in a simple parameterized form. (See also W89-01261) (Author's abstract)
W89-01260

VERTICALLY INTEGRATED SNOW/ICE MODEL OVER LAND/SEA FOR CLIMATE MODELS: 2. IMPACT ON ORBITAL CHANGE EXPERIMENTS,
Tel-Aviv Univ. (Israel). Dept. of Geophysics and Planetary Sciences.
B. U. Neeman, J. H. Joseph, and G. Ohring.
Journal of Geophysical Research (D) JGRDE3, Vol. 93, No. 4, p 3677-3695, April 20, 1988. 13 fig, 6 tab, 55 ref.

Descriptors: *Climatology, *Snow, *Ice, *Sea ice, *Model studies, *Seasonal variation, Precipitation, Thermal capacity, Milankovitch Theory, Mathematical studies.

The vertically integrated formulation (VIF) sea ice/snow and land snow models were implemented in a seasonal dynamic zonally averaged climate model. The simulation of the seasonal cycle of the present climate is compared to climatological data and to results of other models. The addition of ice/snow had interesting consequences for the relative dominance of the opposing winter and summer effects of variations in the Earth's orbital elements. In response to a change between extreme high and low summer insolation orbits, it was found that for sea ice (but not land snow) the winter orbital change dominates over the opposite summer change, causing sea ice shifts which are contrary to the direction predicted by the Milankovitch theory. This is explained by the orbitally induced changes in the length of the seasons, causing insolation anomalies that peak at high latitudes in October and March, coupled with the lag effect of sea ice accretion/melting/heat storage, large thermal capacity of sea water, and sea ice area-thermal inertia feedback. On the other hand, for snow over land the shorter but more pronounced summer orbital change dominates, causing shifts in the region of positive annual snow budgets that agree in direction with the Milankovitch theory. (see also W89-01260) (Author's abstract)
W89-01261

2D. Evaporation and Transpiration

EVAPOTRANSPIRATION OF A WILLOW CARR IN SUMMER,
Ceskoslovenska Akademie Ved, Trebon. Dept. of Hydrobotany.
K. Priban, and J. P. Ondok.
Aquatic Botany AQBODS, Vol. 25, No. 2, p 203-216, September 1986. 5 fig, 2 tab, 24 ref.

Descriptors: *Evapotranspiration, *Wetlands, *Marshes, *Willow trees, Bowen ratio, Marsh plants, Air circulation, Comparison studies.

The daily course of evapotranspiration (E) in a willow carr (stand of Salix cinerea and S. pentandra) was calculated from meteorological data for 3 months (July-September 1983) by the Bowen-ratio method, and compared with evapotranspiration of the surrounding sedge-grass marsh (Carex gracilis, Calmagrostis canescens, and Glyceria maxima) evaluated in the previous years by the same method. A considerable difference was found only for July, which was extremely hot in 1983. The daily average E was 4.8, 3.2, and 2.4 mm per day, in July, August, and September, respectively. The enhancement or reduction of E under non-neutral air stability conditions were less than 10% of E under stable-air conditions. Calculation of E for non-neutral air stratification is discussed. (Author's abstract)
W89-00125

ESTIMATION OF BARE SOIL EVAPORATION FROM AIRBORNE MEASUREMENTS,
Centre de Recherches en Physique de l'Environnement, Issy-les-Moulineaux (France).
For primary bibliographic entry see Field 7B.
W89-00352

EVAPORATION FROM MACKENZIE DELTA LAKES, N.W.T., CANADA,
National Hydrology Research Inst., Saskatoon (Saskatchewan).
P. Marsh, and S. C. Bigras.
Arctic and Alpine Research ATLPAV, Vol. 20, No. 2, p 220-229, May 1988. 4 fig, 5 tab, 34 ref.

Descriptors: *Evaporation, *Lakes, *Lake evaporation, *Microclimatology, *Hydrologic budget, Floods, Runoff, Mackenzie River, Hydrologic cycle.

Evaporation is an important component of the water balance of lakes in the Mackenzie Delta, but the amount of summer evaporation in this area is not well known. A microclimatologic and water balance study conducted over a 5-yr period demonstrated that lake evaporation ranged from 200 to 387 mm per summer. Evaporation was always greater than summer precipitation and in some cases greater than annual precipitation. Measured evaporation varied significantly from lake to lake and was considerably different from that given in standard maps of evaporation over northern Canada. Since these delta lakes receive little runoff from the surrounding basin, lakes that are not flooded by the Mackenzie River experience gradually decreasing water levels. Given sufficient time between flooding events, these lakes will completely dry up. This has important implications for the effect of flow regulation on the hydrology of lakes in the Mackenzie Delta. (Author's abstract)
W89-00438

ANALYSES OF EQUATIONS FOR FREE WATER EVAPORATION ESTIMATES,
Wyoming Univ., Laramie. Dept. of Agricultural Engineering.
K. Warnaka, and L. Pochop.
Water Resources Research WRERAO, Vol. 24, No. 7, p 979-984, July 1988. 7 tab, 17 ref.

Descriptors: *Mathematical analysis, *Free water evaporation, *Evaporation, Statistics, Comparison studies, Mathematical equations, Temperature, Radiation, Wind, Humidity, Wyoming, Regression analysis, Evaporation pans.

A comparison of six equations that estimate free water evaporation using climatological data shows that the equations vary greatly in their ability to define the magnitude and variability of evaporation. The equations compared included the Kohler-Nordeneson-Fox, Kohler-Parmele, Linacre, Priestly-Taylor, Stewart-Rouse, and deBruin, which range from equations requiring only temperature data to those requiring temperature, radiation, wind, and humidity. Several years of monthly estimates for May through September were made at two locations in Wyoming using each of the six equations. Means and standard deviations of the monthly data were calculated and t-tests and regressions comparing the data from the various equations and against pan data were performed. (Author's abstract)
W89-00705

DETERMINATION OF WATER USE EFFICIENCY OF VELD IN THE CENTRAL ORANGE FREE STATE FROM EVAPOTRANSPIRATION MEASUREMENTS (BEPALING VAN WATERVERBRUIKSDOELTREFFENDHEID VAN VELD IN DIE SENTRALE ORANJE-VRYSTAAT VANAF EVAPOTRANSPIRASIEMETINGS),
Orange Free State Univ., Bloemfontein (South Africa).
H. A. Snyman.
Water SA, Vol. 14, No. 3, p 153-158, July 1988. 1 fig, 2 tab, 17 ref. English summary.

Descriptors: *Lysimeters, *Water use efficiency, *Succession, *Evapotranspiration, *South Africa, Veld, Evaportation, Transpiration, Statistics.

Hydraulic non-floating lysimeters were used to determine evapotranspiration and water use efficiency of veld in different successional stages over a four-year period. The mean yearly evapotranspiration from the climax, subclimax and pioneer communities were 614.95 mm; 603.58 mm; and 557.15 mm, respectively. On average, daily evapotranspiration from climax, subclimax and pioneer communities was 1.73 mm; 1.71 mm; and 1.55 mm, respectively. Measured evaporation from bare soil lysimeters was 31.6% less than evapotranspiration from climax grass community. Statistically significant differences ($P < 0,01$) in water use efficiency between the climax, subclimax and pioneer communities were recorded, with averages of 2.6830 kg/ha and 0.9339 kg/ha above-ground by dry matter accumulation for each mm of water evapotranspired. (Author's abstract)
W89-00934

DOES TRANSPIRATION LIMIT THE GROWTH OF VEGETATION OR VICE VERSA,
International Crops Research Inst. for the Semi-Arid Tropics, Patancheru (India).
For primary bibliographic entry see Field 2I.
W89-01013

COMPOSITE METHOD FOR ESTIMATING ANNUAL ACTUAL EVAPOTRANSPIRATION,
General Hydrological Station of Liaoning Province, Shenyang (China).
Y. Hsuen-Chun.
Hydrological Sciences Journal HSJODN, Vol. 33, No. 4, p 345-356, August 1988. 6 tab, 7 ref.

Descriptors: *Model studies, *Evapotranspiration, *Computer models, *China, *Mathematical models, Estimating, Water loss.

A mathematical model for estimating annual actual evapotranspiration was formulated and its parameter estimation methods are described. These include the use of pan data or climatic data; the selection depends on the availability of data. The acceptable accuracy of the model is demonstrated. The model can be applied to various areas in China where there is comparable terrain and range of forest coverage. The model is particularly useful for estimating water losses from ungauged catchments. (Author's abstract)
W89-01141

2E. Streamflow and Runoff

EFFECTS OF RIVER DISCHARGE AND VERTICAL CIRCULATION ON AQUATIC PRIMARY PRODUCTION IN A TURBID LOUISIANA (USA) ESTUARY,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 2L.
W89-00005

SPATIAL AND TEMPORAL VARIABILITY OF THE INDEX OF BIOTIC INTEGRITY IN THREE MIDWESTERN STREAMS,
Illinois Univ. at Urbana-Champaign. Dept. of Ecology, Ethology and Evolution.
J. R. Karr, P. R. Yant, and K. D. Fausch.
Transactions of the American Fisheries Society TAFSA, I Vol. 116, No. 1, p 1-11, January 1987. 5 fig, 4 tab, 30 ref. U.S. Environmental Protection Agency Grants G005103, G005140, 68-01-3584, R806391, CR-807677, and CR-810745), Water Resources Center of the University of Illinois Grant A-093-ILL, Illinois Institute of Natural Resources Grant 20.113.

Descriptors: *Streams, *Aquatic habitats, *Agricultural watersheds, *Index of biotic integrity, *Water quality, *Fish populations, Spatial distribution, Temporal distribution, Soil conservation, Water conservation, Watershed management,

Water quality control, Lotic environment, Illinois, Indiana.

The index of biotic integrity (IBI) has been used to assess the biological quality of flowing water systems in areas throughout the United States. Yet, only rarely has biotic integrity been related to independent measures of water or habitat quality. It is shown that the IBI ranks sites similarly in 2 Illinois watersheds where conditions remained relatively stable during 3 years of sampling. Further, rankings among sites conform to prior assessments of site quality based on habitat and water quality. Neither a species diversity index nor any of the individual metrics that constitute IBI performed as consistently at ranking sites as did the IBI. Sampling should be conducted during early summer to reduce variation due to seasonal fish migration and fall recruitment of young-of-the-year fish. In an Indiana watershed subject to extensive conservation planning, the IBI reflects known habitat and water quality perturbations of both natural and anthropogenic origin. Little or no improvement in biotic integrity was detected following implementation of numerous soil and water conservation practices. (Author's abstract)
W89-00026

INFLUENCE OF TEMPERATURE ON MICROHABITAT CHOICE BY FISHES IN A CALIFORNIA STREAM,
California Univ., Davis. Dept. of Wildlife and Fisheries Biology.
For primary bibliographic entry see Field 2H.
W89-00027

TUMOR FREQUENCIES AND CONTAMINANT CONCENTRATIONS IN BROWN BULLHEADS FROM AN INDUSTRIALIZED RIVER AND A RECREATIONAL LAKE,
National Fisheries Contaminant Research Center, Columbus, OH. Field Research Station.
For primary bibliographic entry see Field 5C.
W89-00028

LONGITUDINAL CHANGES IN FISH ASSEMBLAGES AND WATER QUALITY IN THE WILLAMETTE RIVER, OREGON,
Northrop Services, Inc., Corvallis, OR.
For primary bibliographic entry see Field 2H.
W89-00029

REGULARITIES IN THE FORMATION OF CURVED CHANNELS,
For primary bibliographic entry see Field 2J.
W89-00041

EFFECT OF RUNOFF VARIABILITY ON DEFORMATION OF ERODIBLE CHANNELS NEAR STRUCTURES,
For primary bibliographic entry see Field 2J.
W89-00072

EFFECT OF A HEATED WASTEWATER DISCHARGE UPON RIVER PROTOZOAN SPECIES POOL VARIABILITY THROUGH TIME AND SPACE,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W89-00077

DEVELOPMENT OF MICROORGANISMS ON THE BACKGROUND OF ORGANIC MATTER IN FOREST ECOSYSTEM WATERS,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 2H.
W89-00080

SOLUBILITIES OF TRACE COPPER AND LEAD SPECIES AND THE COMPLEXING CAPACITY OF RIVER WATER IN THE LINGGI RIVER BASIN,
Pertanian Malaysia Univ., Serdang. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W89-00084

BIOMASS AND NUTRITIVE POTENTIAL OF VALLISNERIA AMERICANA MICHX IN NAVIGATION POOL 9 OF THE UPPER MISSISSIPPI RIVER,
Wisconsin Univ.-La Crosse. River Studies Center.
For primary bibliographic entry see Field 2H.
W89-00093

BIOMASS PRODUCTION AND NUTRIENT CYCLING IN AQUATIC MACROPHYTE COMMUNITIES OF THE CHOWAN RIVER, NORTH CAROLINA,
East Carolina Univ., Greenville, NC. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W89-00097

HIGH RATES OF PRODUCTION AND MORTALITY OF SUBMERGED SPARGANIUM EMERSUM REHMAN DURING ITS SHORT GROWTH SEASON IN A EUTROPHIC DANISH STREAM,
Copenhagen Univ., Hilleroed (Denmark). Det Ferskvands-Biologiske Lab.
For primary bibliographic entry see Field 2H.
W89-00099

EFFECTS OF GRAZERS AND LIGHT PENETRATION ON THE SURVIVAL OF TRANSPLANTS OF VALLISNERIA AMERICANA MICHX IN THE TIDAL POTOMAC RIVER, MARYLAND,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2H.
W89-00108

SCANNING ELECTRON MICROSCOPY OF BACTERIA AND DIATOMS ATTACHED TO A SUBMERGED MACROPHYTE IN AN INCREASINGLY POLLUTED STREAM,
Hohenheim Univ., Stuttgart (Germany, F.R.). Inst. fuer Bodenkunde und Standortslehre.
For primary bibliographic entry see Field 5C.
W89-00132

OXYGEN BUDGET OF A RIVER IN SUBMERGED MACROPHYTES (RIVER ZSCHOPAU IN THE SOUTH OF THE GDR),
Technische Univ., Dresden (German D.R.). Sektion Wasserwesen.
For primary bibliographic entry see Field 2H.
W89-00137

WATER QUALITY OF THE TISZA RIVER AND THE ALPAR BACKWATER,
Csongrad County Public Health Station, Szeged (Hungary).
For primary bibliographic entry see Field 5B.
W89-00143

SEASONAL CHANGES OF PHYTOPLANKTON IN THE BACKWATER BOKROS,
Lower-Tisza District Water Authority, Szeged (Hungary).
For primary bibliographic entry see Field 2H.
W89-00147

RIVER EMS: PROCESSES AFFECTING THE BEHAVIOUR OF METALS AND ORGANOCHLORINES DURING ESTUARINE MIXING,
Nederlands Inst. voor Onderzoek der Zee, Texel.
For primary bibliographic entry see Field 5B.
W89-00149

EFFECT OF THE HYDROLOGICAL REGIME ON PRIMARY PRODUCTION IN THE MAIN STREAM AND THE SIDE ARMS OF THE RIVER DANUBE,
Laboratorium Rybarstva a Hydrobiologie, Bratislava (Czechoslovakia).
For primary bibliographic entry see Field 2H.
W89-00162

INTERACTION OF SOME ENVIRONMENTAL FACTORS IN THE DANUBE DELTA ON THE DELIMITATION OF THE VITAL SPACE OCCUPIED BY THE REED, MACE REED AND SEDGE CENOSES (DIE EINWIRKUNG EINIGER UMWELTFAKTOREN DES DONAUDELTAS AUF DIE ABGRENZUNG DES LEBENSRAUMES VON SCHILF-, ROHRKOLBEN- UND SEGGENGESELLSCHAFTEN),
For primary bibliographic entry see Field 2H.
W89-00163

SOME HYDROCHEMICAL, HYDROBIOLOGICAL, AND ICHTHYOLOGICAL FEATURES OF YUGOSLAV PART OF THE DANUBE LASTING FOR SEVERAL YEARS (EINIGE HYDROCHEMISCHE, HYDROBIOLOGISCHE UND ICHTHYOLOGISCHE EIGENSCHAFTEN DER JUGOSLAWISCHEN DONAUSTRECKE IN MEHRJAHRIGEM ZEITRAUM),
Institute for Biological Research, Belgrade (Yugoslavia).
For primary bibliographic entry see Field 5C.
W89-00165

STRUCTURE OF MACROBENTHIC BIOMASS IN THE GRAVEL BED OF THE PRE-ALPINE LOISACH RIVER (DIE STRUKTUR DER MAKROBENTHISCHEN BIOMASSE IN EINEM VORALPINEN SCHOTTERBETT AM BEISPIEL DER MITTLEREN LOISACH),
Bayerische Landesanstalt fuer Wasserforschung, Munich (Germany, F.R.).
For primary bibliographic entry see Field 2H.
W89-00167

PHYTOPLANKTON STUDIES OF SLOWLY RUNNING WATERS: RIVERS DANUBE AND VILS (PHYTOPLANKTONSTUDIEN AN LANGAMFLIESSENDEN GEWASSERN: DONAU UND VILS),
Ministerium fuer Wirtschaft, Mittelstand und Verkehr des Landes Nordrhein-Westfalen, Duesseldorf (Germany, F.R.).
C. Steinberg, B. Heindel, R. Tille-Backhaus, and R. Klee.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 68, No. 3/4, p 437-456, May 1987. 7 fig, 1 tab, 43 ref. English summary.

Descriptors: *Rivers, *Danube River, *Bavaria, *Phytoplankton, Cyanophyta, Diatoms, Nutrients, Species composition, Vils River.

Phytoplankton studies were carried out in the regulated rivers Danube and Vils, Bavaria. Both rivers are considerably loaded with nutrients. Special reference is given to centric diatoms which form the dominating group of phytoplankters. Among these there appears to exist at least two taxa, Cyclostephanos dubius and Skeletonema potamos, which are favored in their growth by river regulation measures. Although cyanobacteria are present in the regulated Danube, they do not dominate in the autotrophic plankton, perhaps because of the limited metabolic flexibility of the cyanobacteria which prevents adaptation to rapidly changing chemical and physical environmental conditions that occur even in regulated streams rather than in lakes. (Sand-PTT)
W89-00172

DETECTION AND ENUMERATION OF ACTINOMYCETES IN THE AUSTRIAN PART OF THE DANUBE BY MEANS OF SELECTIVE MEMBRANE FILTRATION METHODS TOGETHER WITH SOME OTHER BACTERIOLOGICAL PARAMETERS (NACHWEIS UND VORKOMMEN VON ACTINOMYCETEN IN DER OSTERREICHISCHEN DONAU MITTELS SELEKTIVER MEMBRANFILTERVERFAHREN, ZUSAMMEN MIT EINIGEN ANDEREN BAKTERIOLOGISCHEN PARAMETERN),

Bundesanstalt fuer Wasserguete, Vienna (Austria).
For primary bibliographic entry see Field 5A.
W89-00174

DIEL AND SEASONAL CARBON BUDGETS IN TWO COLD SPRING ECOSYSTEMS,
Idaho Div. of Environment, Pocatello.
For primary bibliographic entry see Field 2H.
W89-00177

BENTHIC CYANOPHYTE ASSOCIATIONS IN STREAMS AND LAKES (BENTHISCHE CYANOPHYTEN-GEMEINSCHAFTEN IN BACHEN UND SEEN),
Oesterreichische Akademie der Wissenschaften, Vienna. Biologische Station.
For primary bibliographic entry see Field 2H.
W89-00184

RIVER IMPROVEMENT PLANNING FOR FLOOD PROTECTION IN THE KISO RIVER BASIN UNTIL THE MEIJI ERA, (IN JAPANESE),
Nagoya Inst. of Tech. (Japan). Faculty of Technology.
For primary bibliographic entry see Field 4A.
W89-00204

INHABITANTS' LIFE IN THE LOWLAND OF THE KISO, NAGARA AND IBI RIVERS, (IN JAPANESE),
Tokai Univ., Hiratsuka (Japan).
For primary bibliographic entry see Field 4A.
W89-00205

NUTRIENT LEVELS AND THE DEVELOPMENT OF DIATOM AND BLUE-GREEN BLOOMS IN A SHALLOW AUSTRALIAN ESTUARY,
Western Australia Univ., Nedlands. Dept. of Botany.
For primary bibliographic entry see Field 2H.
W89-00211

ROTIFERS OF WARRI RIVER, NIGERIA,
Benin Univ., Benin City (Nigeria). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W89-00222

EFFECTS OF INCREASING SALINITY ON A CYANOBACTERIA BLOOM IN THE POTOMAC RIVER ESTUARY,
Academy of Natural Sciences of Philadelphia, Benedict, MD. Benedict Estuarine Research Lab.
For primary bibliographic entry see Field 2H.
W89-00231

SPECIES DIVERSITY OF ALGAL FLORA IN VISHWAMITRI RIVER, BARODA (INDIA),
S.S.V.P. Santha's Science Coll., Dhule (India). P.G. Dept. of Botany.
For primary bibliographic entry see Field 2H.
W89-00234

EFFECT OF WITOBELSKIE AND LODZKO-DYMACZEWSKIE LAKES ON PHYTOPLANKTON OF SAMICA STESZEWSKA RIVER,
Adam Mickiewicz Univ., Poznan (Poland). Dept. of Hydrobiology.
For primary bibliographic entry see Field 2H.
W89-00247

IMPACTS OF NAVIGATION ON RIVERINE FISH PRODUCTION IN THE UNITED STATES,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Fisheries and Wildlife Sciences.
For primary bibliographic entry see Field 6G.
W89-00248

FISH PRODUCTION IN THE KANAWHA RIVER AND ITS RELATION TO BARGE TRAFFIC,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Fisheries and Wildlife Sciences.
For primary bibliographic entry see Field 6G.
W89-00249

INFLUENCE OF THE VISTULA RIVER ON DISTRIBUTION OF 226RA IN THE GDANSK BAY,
Polish Academy of Sciences, Sopot. Inst. of Oceanology.
For primary bibliographic entry see Field 2K.
W89-00250

CHEMICAL MECHANISMS OF HEAVY METAL TRANSPORT IN WATERS OF MALA PANEW AND BRYNICA RIVERS (SILESIA, POLAND),
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5B.
W89-00251

EFFECT OF DRAINAGE BASIN ON HEAVY METAL CONCENTRATIONS IN STREAM WATERS IN THE NIEPOLOMICE FOREST,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5B.
W89-00260

FACTORS FORMING THE LEVEL AND DYNAMICS OF NUTRIENT RUNOFF FROM AN AGRICULTURAL WATERSHED,
Institute of Meteorology and Water Management, Warsaw (Poland).
For primary bibliographic entry see Field 5B.
W89-00261

SUSCEPTIBILITY OF YOUNG-OF-THE-YEAR FISHES TO DOWNSTREAM DISPLACEMENT BY FLOODING,
Oklahoma Univ., Norman. Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W89-00295

NUTRIENT AND LIGHT LIMITATION OF ALGAE IN TWO NORTHERN CALIFORNIA STREAMS,
California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 2H.
W89-00296

URBAN RUNOFF SIMULATION MODEL,
Texas A and M Univ., College Station. Dept. of Civil Engineering.
A. Garcia, and W. P. James.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 114, No. 4, p 399-413, July 1988. 8 fig, 1 tab, 20 ref, 2 append.

Descriptors: *Urban runoff, *Simulation analysis, *Model studies, *Rainfall-runoff relationships, Flow profiles, Hydrologic models, Model studies, Mathematical models, Urbanization, Hydrographs, Urban hydrology, Unit hydrographs, Kinematic wave theory.

A study was conducted to determine the sensitivity of the unit hydrograph to the effects of the urbanization process was conducted. The overland flow parameter that defines the degree of urbanization in an urban watershed is the percentage of the total watershed area that is impervious. Furthermore, the parameter which defines the degree of urbanization in the channelized flow portion of a watershed is the channel roughness coefficient. Several rainfall-runoff simulations were conducted to determine the hydrologic response of the unit hydrograph to the impact of urbanization. A hydrologic model was formulated for an urban catchment located at Houston, Texas, using the kinematic wave model developed by the Hydrologic Engineering Center (HEC). The model was used to simulate various degree of urbanization by allowing the percentage of watershed imperviousness and the channel roughness coefficient to vary from simulation to simulation. A system of regression equations was developed to quantify the impact of urbanization on the unit hydrograph. The equations were incorporated into the A and M Watershed Model and verified by modeling three test watersheds. Results of the study indicate that: (1) The percentage impervious area and average channel Manning n value are valid parameters for estimating the effect of urbanization on the runoff characteristics of the watershed; (2) The unit hydrograph concept can be applied to small urban watersheds; (3) The unit hydrograph peaking factors, when applied to the two-parameter gamma function, rural unit hydrograph, gave reasonable results for runoff simulation in urban areas; and (4) Results of the study indicate that additional research is necessary to more accurately estimate the runoff volume more accurately. (Lantz-PTT)
W89-00301

MULTICRITERION STORMWATER MANAGEMENT METHODS,
Maryland Univ., College Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W89-00302

REGRESSION ESTIMATES FOR TOPOLOGICAL-HYDROGRAPH INPUT,
Geological Survey, Denver, CO.
M. R. Karlinger, D. P. Guertin, and B. M. Troutman.
Journal of Water Resources Planning and Management JWRMD5, Vol. 114, No. 4, p 446-456, July 1988. 7 tab, 13 ref, 3 append.

Descriptors: *Unit hydrographs, *Rainfall-runoff relationships, *Celerity, *Flood hydrographs, *Flood waves, Regression analysis, Hydrographs, Wyoming, Catchment areas, Model studies, Channels, Slopes, Flood peak.

Physiographic, hydrologic, and rainfall data from 18 small drainage basins in semiarid, central Wyoming were used to calibrate topological, unit-hydrograph models for celerity, the average rate of travel of a flood wave through the basin. The data set consisted of basin characteristics and hydrologic data for the 18 basins and rainfall data for 68 storms. Calibrated values of celerity and peak discharges subsequently were regressed as a function of the basin characteristics and excess rainfall volume. Predicted values obtained in this way can be used as input for estimating hydrographs in ungaged basins. The regression models included ordinary least-squares and seemingly unrelated regression. This seemingly unrelated regression model jointly estimated the celerity and peak discharge. Results indicate that a regional regression of celerity on physical basin characteristics of magnitude, mean link lengths of stream channels, and channel slope can explain 67% of the variability in celerity between basins. In addition, when excess rainfall volume is available, peak-discharge regression has more than 90% explained variation. Because of the interdependence between celerity and peak discharge, explained variation in both regressions, considered as a system of equations, is increased substantially as indicated by the decrease of standard error in model parameters. (Lantz-PTT)
W89-00304

UNIONID (MOLLUSCA:BIVALVIA) FAUNA OF THE SHENANGO RIVER IN MERCER COUNTY, PENNSYLVANIA,
Pennsylvania State Univ. Shenango Valley Campus, Sharon.
For primary bibliographic entry see Field 5C.
W89-00312

MICROHABITAT USE BY AN ASSEMBLAGE OF CALIFORNIA STREAM FISHES: DEVEL-

OPING CRITERIA FOR INSTREAM FLOW DETERMINATIONS,
California Univ., Davis. Dept. of Wildlife and Fisheries Biology.
For primary bibliographic entry see Field 6D.
W89-00319

RELATIONS BETWEEN HABITAT VARIABLES AND CHANNEL CATFISH POPULATIONS IN PRAIRIE STREAMS,
Oklahoma Cooperative Fishery Research Unit, Stillwater.
For primary bibliographic entry see Field 2H.
W89-00325

RUNOFF GENERATION IN A PLOUGH-DRAINED PEAT BOG IN SOUTHERN SCOTLAND,
Centro de Estudos de Pedologia, Lisbon (Portugal).
For primary bibliographic entry see Field 4C.
W89-00345

SEDIMENT DELIVERY IN A SEMI-ARID COASTAL STREAM,
San Diego State Univ., CA.
For primary bibliographic entry see Field 2J.
W89-00346

EFFECT OF LOGGING AND REGENERATION ON GROUNDWATER, STREAMFLOW AND STREAM SALINITY IN THE SOUTHERN FOREST OF WESTERN AUSTRALIA,
Water Authority of Western Australia, Perth.
For primary bibliographic entry see Field 4C.
W89-00350

LOCATION-INVARIANT PLOTTING POSITIONS FOR PWM ESTIMATION OF THE PARAMETERS OF THE GEV DISTRIBUTION,
Saint Andrews Univ. (Scotland). School of Mathematical Sciences.
C. D. Sinclair, and M. I. Ahmad.
Journal of Hydrology JHYDA7, Vol. 99, No. 3/4, p 271-279, May 30, 1988. 9 tab, 10 ref.

Descriptors: *Mathematical models, *Probability weighted moments, *Plotting positions, *Probability distribution, *Flood frequency, *Flood forecasting, Factor analysis, Hydrologic models, Flood data.

Location-invariance is introduced in the context of use of plotting positions in estimating, by the method of probability weighted moments (PWM), the parameters of the General Extreme Value (GEV) distribution for flood frequency data. It is demonstrated that this is an important factor that should be taken into account in the selection of an appropriate plotting position, since otherwise the estimate of shape parameter may not be independent of location. A location-invariant plotting position is derived for the GEV. It is also location-invariant for the log-logistic distribution. (Author's abstract)
W89-00351

EFFECTS OF TEMPERATURE AND STREAMFLOW ON TIME AND DURATION OF SPAWNING BY SMALLMOUTH BASS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Fisheries and Wildlife Sciences.
For primary bibliographic entry see Field 2H.
W89-00373

EFFECTS OF STREAM CLEANING ON JUVENILE COHO SALMON AND DOLLY VARDEN IN SOUTHEAST ALASKA,
Pacific Northwest Forest and Range Experiment Station, College, AK. Inst. of Northern Forestry.
For primary bibliographic entry see Field 2H.
W89-00374

FEEDING OF A FRESHWATER FLAGELLATE, BODO SALTANS, ON DIVERSE BACTERIA,
Southampton Univ. (England). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W89-00381

VARIATIONS OF RUNOFF IN THE HIGH PLAINS SECTION OF THE SMOKY HILL DRAINAGE, 1951-1980,
Fort Hays State Univ., Hays, KS. Dept. of Earth Science.
For primary bibliographic entry see Field 2A.
W89-00394

HABITAT USE OF TWO DARTER SPECIES IN GLOVER RIVER, OKLAHOMA,
Fish and Wildlife Service, Anchorage, AK. Alaska Regional Office.
For primary bibliographic entry see Field 2H.
W89-00396

LONG-TERM ECOLOGICAL RESEARCH ON ILLINOIS RIVERS,
Illinois State Water Survey, Champaign. Surface Water Section.
For primary bibliographic entry see Field 2H.
W89-00401

DISTRIBUTION OF CHITINOLYTIC BACTERIA IN VARIOUS AQUATIC SYSTEMS: A COMPARATIVE STUDY,
Trinity Christian Coll., Palos Heights, IL.
For primary bibliographic entry see Field 2H.
W89-00402

RIVER-FORCED ESTUARINE PLUMES,
Maryland Univ., Cambridge. Horn Point Environmental Labs.
For primary bibliographic entry see Field 2L.
W89-00414

ECOLOGICAL AND SAPROBIOLOGICAL STATUS OF THE RHINE (DER OEKOLOGISCH-SAPROBIOLOGISCHE ZUSTAND DES RHEINS),
Bayer A.G., Leverkusen (Germany, F.R.). Umweltschutz/Analytik.
For primary bibliographic entry see Field 2H.
W89-00498

INFLUENCE OF SELECTED ORGANIC COMPLEXING AGENTS ON THE SORPTION OF HEAVY METALS IN RIVER SEDIMENTS (EINFLUSS AUSGEWAEHLTER ORGANISCHER KOMPLEXBILDNER AUF DIE SORPTION VON SCHWERMETALLEN AN GEWAESSERSEDIMENTE),
Technische Univ. Hamburg-Harburg (Germany, F.R.). Arbeitsbereich Umweltschutztechnik.
For primary bibliographic entry see Field 5B.
W89-00501

DETERMINATION OF GROSS-BETA RADIOACTIVITY IN WATER OF THE CHANGJIANG RIVER AND SEA WATER NEAR ITS ENTRANCE TO SEA, (IN CHINESE),
Academia Sinica, Qingdao (China). Inst. of Oceanology.
For primary bibliographic entry see Field 2H.
W89-00534

ESTIMATE OF THE VARIABILITY IN BIOTRANSFORMATION KINETICS OF XENOBIOTICS IN NATURAL WATERS BY AUFWUCHS COMMUNITIES,
Environmental Research Lab., Athens, GA.
For primary bibliographic entry see Field 5B.
W89-00559

CORRELATION OF SOME ORGANIC POLLUTION FACTORS IN WATER SYSTEMS IN NORTHERN GREECE,
Thessaloniki Univ., Salonika (Greece). Lab. of Analytical Chemistry.
For primary bibliographic entry see Field 5B.
W89-00566

COMPARATIVE STUDY OF HEAVY METALS POLLUTION IN VARIOUS RIVERS AND LAKES OF NORTHERN GREECE,
Thessaloniki Univ., Salonika (Greece). Environmental Pollution Control Lab.
For primary bibliographic entry see Field 5B.
W89-00571

BIOAVAILABILITY OF POLYCHLORINATED DIBENZO-P-DIOXINS AND DIBENZOFURANS FROM CONTAMINATED WISCONSIN RIVER SEDIMENT TO CARP,
Environmental Research Lab.-Duluth, MN.
For primary bibliographic entry see Field 5B.
W89-00583

SEDIMENTATION OF 74 PCB CONGENERS IN THE UPPER HUDSON RIVER,
New York State Dept. of Health, Albany. Wadsworth Center for Labs. and Research.
For primary bibliographic entry see Field 5B.
W89-00584

EFFECTS OF HIGH LEVELS OF POLYCYCLIC AROMATIC HYDROCARBONS ON SEDIMENT PHYSICOCHEMICAL PROPERTIES AND BENTHIC ORGANISMS IN A POLLUTED STREAM,
Virginia Inst. of Marine Science, Gloucester Point. Div. of Chemistry and Toxicology.
For primary bibliographic entry see Field 5C.
W89-00589

POLYCHLORINATED BIPHENYLS IN THE KUPA RIVER, CROATIA, YUGOSLAVIA,
Sisak Medical Center (Yugoslavia). Dept. of Sanitary Chemistry.
For primary bibliographic entry see Field 5B.
W89-00609

POLYBROMINATED BIPHENYL ETHERS IN MARINE FISH, SHELLFISH, AND RIVER AND MARINE SEDIMENTS IN JAPAN,
Osaka Prefecture Inst. of Public Health (Japan).
For primary bibliographic entry see Field 5B.
W89-00610

CHLORINATED HYDROCARBONS IN SEDIMENTS OF THE ELBE RIVER AND THE ELBE ESTUARY,
Alfred-Wegener-Inst. fuer Polarforschung, Bremerhaven (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W89-00614

EVALUATION OF AQUATIC ENVIRONMENTAL FATE OF 2,4,6-TRICHLOROPHENOL WITH A MATHEMATICAL MODEL,
Mitsubishi-Kasei Inst. of Toxicological and Environmental Sciences, Yokohama (Japan).
For primary bibliographic entry see Field 5B.
W89-00616

BARRIER/ESTUARINE PROCESSES. BOT RIVER ESTUARY: AN INTERPRETATION OF AERIAL PHOTOGRAPHS,
Specialist Offshore Surveys Pty Ltd., Newlands (South Africa).
For primary bibliographic entry see Field 2L.
W89-00650

HYDROLOGY OF THE BOT RIVER ESTUARY,
National Research Inst. for Oceanology, Stellenbosch (South Africa).
For primary bibliographic entry see Field 2L.
W89-00654

ALGAL STUDIES OF THE RIVER ELY, SOUTH WALES, U.K.: I. PHYTOPLANKTON,
University Coll., Cardiff (Wales). Dept. of Plant Science.
For primary bibliographic entry see Field 2H.
W89-00678

ALGAL STUDIES OF THE RIVER ELY, SOUTH WALES, U.K.: II. EPILITHIC ALGAE,
University Coll., Cardiff (Wales). Dept. of Plant Science.
For primary bibliographic entry see Field 2H.
W89-00679

EFFECTS OF CURRENT VELOCITY ON THE PHYSICAL STRUCTURING OF DIATOM (BACILLARIOPHYCEAE) COMMUNITIES,
Bowling Green State Univ., OH. Dept. of Biological Sciences.
M. A. Lamb, and R. L. Lowe.
Ohio Journal of Science OJSCA9, Vol. 87, No. 3, p 72-78, June 1987. 2 fig, 2 tab, 37 ref.

Descriptors: *Limnology, *Diatoms, *Phytoplankton, *Algae, *Water currents, *Rivers, Physical properties, Species diversity, Succession, Velocity, Current velocity, Maumee River, Ohio, Electron microscopy, Algal growth.

Diatom-dominated periphyton communities growing under different current velocities on precleaned rock substrates were harvested from the Maumee River, Ohio, during the winter of 1980. Analysis of the initial stages of colonization using scanning electron microscopy revealed that the communities were very similar in composition, but that diatom cell densities were more than three times as dense in the slow current (15 cm/s) as in the fast current (40 cm/s). The diatom communities were described quantitatively in an attempt to determine how physical structuring was influenced by current velocity. Slow-current communities were shown to exhibit more vertical height development. Slow-current communities were also shown to create and develop more usable substrates for colonization within the community. Both of these aspects of physical structuring led to a greater community diversity and more rapid successional development for communities in the slow current. (Author's abstract)
W89-00686

APPLICATION OF PRINCIPAL COMPONENT ANALYSIS TO LONG-TERM RESERVOIR MANAGEMENT,
Quebec Univ., Montreal. Ecole de Technologie Superieure.
For primary bibliographic entry see Field 6A.
W89-00698

ESTIMATION OF THE TIME SCALE OF THE GEOMORPHOLOGIC INSTANTANEOUS UNIT HYDROGRAPH FROM EFFECTIVE STREAMFLOW VELOCITY,
Palermo Univ. (Italy). Dipt. di Economia Ingeneria e Technologie Agrarie.
C. Agnese, F. D'Asaro, and G. Giorano.
Water Resources Research WRERAO, Vol. 24, No. 7, p 969-978, July 1988. 19 fig, 2 tab, 37 ref.

Descriptors: *Streamflow, *River basins, *Unit hydrographs, *Geomorphology, *Rainfall-runoff relationhips, *Temporal distribution, Timing, Italy, Stream order, Hydrologic models, Mathematical studies.

The greatest difficulty in applying the geomorphologic instantaneous unit hydrograph is the estimation of the time scale of the hydrologic response of a basin. The time scale is derived from the effective streamflow velocity of the highest-order stream and the spatial distribution of velocity throughout the stream network. The latter is described by a dimensionless geomorphologic function with a single-shape parameter. The proposed method is applied to some Italian basins. (Author's abstract)
W89-00704

STREAM CHEMISTRY IN THE NEW JERSEY PINELANDS: THE INFLUENCE OF PRECIPITATION AND WATERSHED DISTURBANCE,
Rutgers - The State Univ., Camden, NJ. Dept. of Biology.
For primary bibliographic entry see Field 5B.
W89-00716

CHEMICAL-HYDROLOGIC INTERACTIONS IN THE NEAR-STREAM ZONE,
Agricultural Research Service, University Park, PA. Northeast Watershed Research Center.
H. B. Pionke, J. R. Hoover, R. R. Schnabel, W. J. Gburek, and J. B. Urban.
Water Resources Research WRERAO, Vol. 24, No. 7, p 1101-1110, July 1988. 5 fig, 29 ref.

Descriptors: *Surface-groundwater relations, *Rainfall-runoff relationships, *Watersheds, *Streams, *Storm runoff, Models, Pennsylvania, Water chemistry, Nitrates, Ammonia, Phosphorus, Orthophosphates, Seepage, Base flow, Hydrologic models, Water table fluctuations.

The chemical and hydrologic responses of a 9.9-ha Pennsylvania hill-land watershed to a typical summer storm event were determined and compared. Patterns and the relative magnitudes of NO3, NH4, and total phosphorus (P), and orthophosphate (PO4) concentrations observed in seepage, surface runoff, storm flow, base flow, and rainfall fit those hypothesized from the storm hydrograph and associated water table responses observed in the near-stream zone. Nitrate concentrations in seepage and base flow were similar and, typically, exceeded those in seepage and base flow by 2-20 times. The findings, presented in a hydrologically based framework for this watershed, provide a conceptual model of how the near-storm zone operates during and following storm events. (Author's abstract)
W89-00717

USE OF MAP ANALYSIS TO ELUCIDATE FLOODING IN AN AUSTRALIAN RIPARIAN RIVER RED GUM FOREST,
Melbourne Univ., Parkville (Australia). Forestry Section.
L. J. Bren, I. C. O'Neill, and N. L. Gibbs.
Water Resources Research WRERAO, Vol. 24, No. 7, p 1152-1162, July 1988. 15 fig, 5 tab, 22 ref.

Descriptors: *Map analysis, *Flood frequency, *Rivers, *Flooding, *Flood plains, *Forests, *Regulated flow, Red gum, Australia, Murray River, Spatial distribution, Vegetation regrowth, Time series analysis, Wetlands, Irrigation requirements.

Red gum (Eucalyptus camaldulensis) forests occur on extensive flood plains along the river Murray in Australia. This type of forest is unusual because of its high quality in a semiarid area, the absence of woody species other than red gum, and its survival on a deep, intractable, swelling clay soil of depths exceeding 20 m. This soil probably acts as an aquiclude. The forests require flooding to thrive and regenerate. For many years there has been speculation that irrigation regulation of the river was reducing forest flooding. A grid cell analysis of flood maps of areas flooded over a period of 22 years showed that vegetation communities and forest site quality were statistically related to the flood frequencies of sites. The percentage of forest inundated was dependent on the peak daily flow during the period of inundation. A historical analysis of the estimated percentage of forest inundated showed a substantial influence of river regulation on both timing and extent of inundation. Estimates of historical floodings showed that the environment is one that changes rapidly from wetland to dry land. Although not without limitations, the analysis produced information not available from other sources. (Author's abstract)
W89-00722

MAXIMUM LIKELIHOOD CRITERION FOR USE WITH DATA COLLECTED AT UNEQUAL TIME INTERVALS,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
Q. Duan, S. Sorooshian, and R. P. Ibbitt.
Water Resources Research WRERAO, Vol. 24, No. 7, p 1163-1173, July 1988. 9 fig, 6 tab, 19 ref.
NSF Grant INT-8413539 and ECE-8610584.

Descriptors: *Model studies, *Rainfall-runoff relationships, *Flood forecasting, *Mathematical models, *River basins, Catchment areas, Maximum likelihood criterion, New Zealand, Pukeiti Catchment, Hydrologic data collection, Temporal distribution.

A new maximum likelihood (NMLE) criterion suitable for model calibration using data which are recorded at unequal time intervals and contain autocorrelated errors is derived. Validation of the NMLE criterion has been carried out both on a simple two-parameter reservoir model using synthetically generated data and on a more complicated hillslope model using real data from the Pukeiti catchment in New Zealand. Comparison between the NMLE criterion and the simple least squares criterion reveals the superiority of the NMLE. Comparison between the NMLE criterion and the maximum likelihood criterion for the autocorrelated case proposed by Sorooshian has shown that both criteria would yield results with no practical difference if equal time interval data were used. However, the NMLE criterion can work on variable time interval data, which provide more information than equal time interval data and therefore produce better visual results in hydrologic simulations. (Author's abstract)
W89-00723

ANNUAL FLOW STATISTICS FOR UNGAGED STREAMS IN IDAHO,
Idaho Univ., Moscow. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W89-00753

FRESH WATER INFLOWS TO THE FIRTH OF CLYDE,
Clyde River Purification Board, East Kilbride (Scotland).
For primary bibliographic entry see Field 2L.
W89-00801

BASIN SEDIMENTATION AND THE GROWTH OF PROGRADING DELTAS,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia).
For primary bibliographic entry see Field 2J.
W89-00832

TRENDS IN LEAD CONCENTRATIONS IN MAJOR U.S. RIVERS AND THEIR RELATION TO HISTORICAL CHANGES IN GASOLINE-LEAD CONSUMPTION,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 5B.
W89-00868

DRY STREAM REACHES IN CARBONATE TERRANES: SURFACE INDICATORS OF GROUND-WATER RESERVOIRS,
Geological Survey, Nashville, TN.
For primary bibliographic entry see Field 7B.
W89-00870

ALTERNATIVE STRATEGIES FOR STORM-WATER DETENTION,
Syracuse Univ., NY. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W89-00875

FLOW CAPACITY OF CULVERTS ON OREGON COAST RANGE FOREST ROADS,
Riverside Technology, Fort Collins, CO.
For primary bibliographic entry see Field 8B.
W89-00878

CONFIDENCE INTERVALS FOR FLOOD EVENTS UNDER A PEARSON 3 OR LOG PEARSON 3 DISTRIBUTION,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
For primary bibliographic entry see Field 7C.
W89-00879

SOME BIOLOGICAL ASPECTS OF LIZA ABU (HECKEL) MUGILIDAE, IN AL-DAOODI DRAIN, (BAGHDAD, IRAQ),
Scientific Research Council, Baghdad (Iraq).
For primary bibliographic entry see Field 2H.
W89-00890

ESTIMATION OF CATCHMENT RAINFALL UNCERTAINTY AND ITS INFLUENCE ON RUNOFF PREDICTION,
Technical Univ. of Denmark, Lyngby.
For primary bibliographic entry see Field 2A.
W89-00892

FRICTION FACTOR EVALUATION IN GRAVEL-BED RIVERS,
Universita di Reggio Calabria, Cosenza (Italy). Dipt. di Difesa del Suolo.
For primary bibliographic entry see Field 8B.
W89-00898

GENERALIZED METHOD OF MOMENTS APPLIED TO LP3 DISTRIBUTION,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
B. Bobee, and F. Ashkar.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 114, No. 8, p 899-909, August 1988. 15 ref. Natural Sciences and Engineering Research Council Canada Grants NSERC A-8399 and A-5797, and Strategic Grant G-1617.

Descriptors: *Pearson distribution, *Flood flow, *Flood forecasting, *Flood data, *Statistical methods, Estimating equations, Probability distribution, Statistical analysis.

The log-Pearson type 3 (LP3) distribution is recommended in the United States by the Water Resources Council (WRC) as the parent distribution to maximum annual flood series. The parameter estimation technique proposed for this distribution consists in applying a logarithmic transformation to the observed flood sample and then applying the method of moments to these logarithmic values using moments of order 1, 2, and 3 (mean, variance, and coefficient of skew) in log space. Other methods have been proposed which use only moments in real space such as the mean, variance, geometric mean, harmonic mean, etc. of the observed sample, or combination of moments in real and log space (method of 'mixed moments'). There are many other versions of the method of moments which have yet to be explored and evaluated. To help motivate this kind of exploration, a general formula was derived for the variance of the T-year event X sub T obtained by a method called the Generalized Method of Moments (GMM) which combines any three moments of the LP3 distribution. A special case of the GMM is presented called the Sundry Averages Method (SAM) which uses the harmonic, geometric, and arithmetic means of the distribution. (Author's abstract)
W89-00901

PLUNGING AND STREAMING FLOWS IN POOL AND WEIR FISHWAYS,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
N. Rajaratnam, C. Katopodis, and A. Mainali.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 114, No. 8, p 939-944, August 1988. 1 fig, 4 ref.

Descriptors: *Fish passages, *Weirs, *Flow characteristics, *Flow pattern, Mathematical analysis, Plunging flow, Streaming flow.

A pool-and-weir fishway consists of a number of pools formed by a series of weirs. It is known that the flow over the weirs can be either in the plunging or streaming mode. When the flow is in the plunging mode, the water level in the pool immediately below the weir is generally below the crest of the weir. In the streaming flow mode, a surface stream appears to flow over the crest of the weirs, skimming over the water surface in the pools in between. For pool-weir fishways in the plunging flow regime, a simple weir analysis has been found to be adequate with the dimensionless discharge Q sub + = 0.61. For the surface streaming state, the dimensionless discharge Q sub * was found to be equal to 1.5 x the square root of (L/d), where L is the length of the pool and d is the depth of the surface stream. A criterion has been established to predict the transition from plunging to surface streaming state. (VerNooy-PTT)
W89-00904

GENERALIZED RECTANGULAR WEIR EQUATIONS,
Roorkee Univ. (India). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W89-00905

PRIMARY PRODUCTION IN THE ORINOCO RIVER,
Colorado Univ. at Boulder. Dept. of Environmental, Population, and Organismic Biology.
For primary bibliographic entry see Field 2H.
W89-00907

DRAINAGE BASIN PEAK DISCHARGE RATING CURVE,
W. F. Rogers, and V. P. Singh.
Hydrological Processes HYPRE3, Vol. 2, No. 3, p 245-253, July-September 1988. 3 fig, 6 ref. NSF-INT-84-00205.

Descriptors: *Peak discharge, *Stream gaging, *Catchment areas, *Flood peak, *Discharge hydrographs, *Graphical methods, Graphical analysis, Stream gages, Flood hydrographs, Snowmelt.

The stream gauge rating curve for a drainage basin can be transformed into a drainage basin peak discharge rating curve that is more stable than the rating curve from which it is derived. The resulting drainage basin peak discharge rating curve can be used to predict peak discharge, identify anomalous discharges caused by channel obstructions or other causes, evaluate the effect of flood retarding structures, and evaluate historical records. The drainage basin peak discharge rating curve is valid for drainage basins of any size, for any discharge up to the time of concentration, and for snowmelt. The slope, m, of the log-linear relationship defined by the peak discharge rating curve represents the degree of nonlinearity of the drainage basin hydrologic characteristics and is an individual characteristic of each drainage basin. The value of m is closely related to the skewness of the annual series. (Author's abstract)
W89-00913

STREAM NITRATE LEVELS IN A SMALL CATCHMENT IN SOUTH WEST ENGLAND OVER A PERIOD OF 15 YEARS (1970 - 1985),
Oxford Univ. (England). Geography School.
For primary bibliographic entry see Field 5B.
W89-00915

HYDROLOGICAL CHANGES AND THE RIVER REGULATION IN THE UK,
University Coll. of Wales, Aberystwyth. Dept. of Geography.
For primary bibliographic entry see Field 4A.
W89-00957

IMPACT OF RIVER REGULATIONS ON INVERTEBRATE COMMUNITIES IN THE U.K.,
Nature Conservancy Council, Peterborough (England).
For primary bibliographic entry see Field 4A.
W89-00959

LANDSCAPE AND RAINFALL INDICES FOR PREDICTION OF STREAMFLOW SIMILARITIES IN THE HUNTER VALLEY, AUSTRALIA,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Water Resources.
B. G. Cook, P. Laut, M. P. Austin, D. N. Body, and D. P. Faith.
Water Resources Research WRERAO, Vol. 24, No. 8, p 1283-1298, August 1988. 8 fig, 7 tab, 33 ref.

Descriptors: *Rainfall-runoff relationships, *Streamflow, *Data interpretation, *Topography, *Rainfall index, *Australia, Model studies, Mathematical equations, Flow characteristics, Surface water, Precipitation, Runoff, Prediction, Rainfall, Catchment areas, Watersheds.

Multivariate analysis of grid cell landscape data and of daily rainfall and streamflow data is used to locate mesoscale catchments of the Hunter valley, Australia, in multidimensional spaces that define landscape, rainfall, and streamflow indices for each catchment. Multiple regression equations are developed and validated for predicting indices of streamflow from those of landscape and rainfall. This methodology provides a basis for using landscape and rainfall data to locate gauged and ungauged catchments in common space in which proximity between catchments predicts similarity of streamflow. (Author's abstract)
W89-00972

ASSESSING THE BIRKENES MODEL OF STREAM ACIDIFICATION USING A MULTI-SIGNAL CALIBRATION METHODOLOGY,
Senter for Industriforskning, Oslo (Norway).
For primary bibliographic entry see Field 7B.
W89-00974

FRACTAL NATURE OF RIVER NETWORKS,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
D. G. Tarboton, R. L. Bras, and E. Rodriguez-Iturbe.
Water Resources Research WRERAO, Vol. 24, No. 8, p 1317-1322, August 1988. 5 fig, 1 tab, 21 ref, 2 append.

Descriptors: *Mathematical analysis, *Fractals, *Geomorphology, *Drainage patterns, *River systems, *Watersheds, *Tributaries, Streamflow, Channel morphology, Channels, Streams, Catchment areas, Watercourses.

Ever since Mandelbrot (1975, 1983) coined the term, there has been speculation that river networks are fractals. Here the authors report analyses done on river networks to determine their fractal structure. The authors find that the network as a whole, although composed of nearly linear members, is practically space filling with fractal dimension near 2. The empirical results are backed by a theoretical analysis based on long-standing hydrologic concepts describing the geometric similarity of river networks. These results advance the understanding of the geometry and composition of river networks. (Author's abstract)
W89-00975

ASSESSMENT OF FLOOD FREQUENCY MODELS USING EMPIRICAL DISTRIBUTION FUNCTION STATISTICS,
Saint Andrews Univ. (Scotland). School of Mathematical Sciences.
M. I. Ahmad, C. D. Sinclair, and B. D. Spurr.
Water Resources Research WRERAO, Vol. 24, No. 8, p 1323-1328, August 1988. 1 fig, 6 tab, 15 ref.

Descriptors: *Model studies, *Flood frequency, *Flood forecasting, *Flood data, *Statistical analysis, Hydrological regime, Hydrologic properties, Suface water, Rainfall-runoff relationships, Probabilistic process, Statistical methods, Distribution graphs.

Tests of goodness of fit of the generalized extreme value (GEV) and the generalized logistic (GL) distribution based on the empirical distribution function are described. Significance points for the Anderson-Darling and a recently introduced modified Anderson-Darling test statistic are obtained by simulation. For each of these distributions, the unknown parameters are estimated from the sample data using probability weighted moments. Approximations for the probability of significance of these test statistics are provided. This enables assessment of GEV and GL flood frequency models for hydrological region based on all the annual maximum series of the region. (Author's abstract)
W89-00976

METHODS AND MERITS OF REGIONAL FLOOD FREQUENCY ANALYSIS,
University Coll., Galway (Ireland). Dept. of Engineering Hydrology.
C. Cunnane.
Journal of Hydrology JHYDA7, Vol. 100, No. 1/3, p 269-290, July 30, 1988. 57 ref.

Descriptors: *Hydrology, *Rivers, *Rainfall-runoff relationships, *Flood frequency, *Regional analysis, *Literature reviews, Model studies, Mathematical models, Prediction, Runoff, Dalrymple flood frequency method, Statistical analysis, Probabilistic process, Two component extreme value method, Box-Cox transformation, Threshold sample method, Censored sample method.

Regional flood frequency analysis (RFFA) enables flood quantile estimates for any site in a region to be expressed in terms of flood data recorded at all gaging sites in that region, including those at the specific site. Most RFFA differs from the regional smoothing of rainfall maps or methods used in geostatistics where a rainfall/geostatistic quantity is assumed to consist of a drift component, smoothly varying in space, and a random component, this random component also having some spatial persistence through its correlation structure. Regional homogeneity depends on which aspect of flood frequency behavior is considered to be homogeneous. Regional homogeneity can even be considered as a special case of regional smoothing where the drift component is constant. Measures on which regional homogeneity is judged are dimensionless scale and shape parameters. The magnitudes of annual maximum flow in rivers in the same region may show some association or dependence for the following reasons: (1) In some years the annual maximum flow at all sites is due to a single widespread event which affects all catchments in the same qualitative way. (2) In relatively dry years during which peak flows are low generally over the entire region, all annual maxima will be generally low even if they are not caused by the same meteorological event. (3) In the case of persistent absence of extreme precipitation in widespread events, annual peak flows of moderate magnitude occur at all sites, generally caused by different events. Twelve RFFA schemes are described, the common elements identified, and the case in favor of RFFA is presented. These are station year methods, Dalrymple's method, methods based on dimensionless moments, methods based on order statistics, record extension methods, U.S. Water Resources Council method, Bayesian methods, method based on standardized probability weighted moments, two-component extreme value method, regional application of Box-Cox transformation, threshold and censored sample methods, and simultaneous at-site and regional parameter estimation. (Cassar-PTT)
W89-01020

HYDROLOGICAL HETEROGENEITY CATCHMENT MORPHOLOGY AND CATCHMENT RESPONSE,
Lancaster Univ. (England). Centre for Research on Environmental Systems.
For primary bibliographic entry see Field 2A.
W89-01024

OPERATIONAL MODELS FOR FLOOD CALCULATIONS,
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Hydrologie und Wasserwirtschaft.
For primary bibliographic entry see Field 2A.
W89-01030

BACTERIAL PRODUCTION IN FRESH AND SALTWATER ECOSYSTEMS: A CROSS-SYSTEM OVERVIEW,
Institute of Ecosystem Studies, Millbrook, NY.
For primary bibliographic entry see Field 2H.
W89-01034

DISCRIMINATION BETWEEN ALGAE AND ARTIFICIAL PARTICLES BY FRESHWATER AND MARINE COPEPODS,
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.). Dept. of Ecophysiology.
For primary bibliographic entry see Field 2H.
W89-01047

RECORDS OF RIVERBORNE TURBIDITY CURRENTS AND INDICATIONS OF SLOPE FAILURES IN THE RHONE DELTA OF LAKE GENEVA,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
For primary bibliographic entry see Field 2J.
W89-01049

DERIVATION OF BASEFLOW RECESSION CONSTANT USING COMPUTER AND NUMERICAL ANALYSIS,
Maiduguri Univ. (Nigeria).
M. D. Bako, and D. N. Hunt.
Hydrological Sciences Journal HSJODN, Vol. 33, No. 4, p 357-367, August 1988. 2 tab, 6 ref.

Descriptors: *Low flow, *Flow, *Statistical analysis, *Base flow, Recession curve, Rivers, Computer models, Mathematical analysis.

A baseflow recession constant, which can be derived from a simple exponential equation, was used to characterize the behavior of low flows. The baseflow recession constant is a powerful tool for characterizing the behavior of low flows. GENSTAT, a computer statistical package based on an analysis of covariance, speeds up the derivation and eases the laborious and subjective nature of many present methods. The three most commonly used methods for construction of a master recession curve are reviewed, including: (1) strip method, (2) correlation method, and (3) tabulating method. It is concluded that a statistical package such as GENSTAT (or a simple computer program based on the theory of covariance) is a fast, reliable and objective method of estimating the baseflow recession constant. (Miller-PTT)
W89-01142

APPROXIMATE CONFIDENCE INTERVALS FOR VERIFICATION CRITERIA OF THE WMO INTERCOMPARISON OF SNOWMELT RUNOFF MODELS,
McGill Univ., Montreal (Quebec). Dept. of Civil Engineering.
G. Cavadias, and G. Morin.
Hydrological Sciences Journal HSJODN, Vol. 33, No. 4, p 369-377, August 1988. 3 fig, 3 tab, 21 ref.

Descriptors: *Statistical analysis, *Snowmelt, *Runoff forecasting, *Model studies, *Hydrologic models, Jackknife statistic, Performance evaluation.

The application of the jackknife method provides approximate confidence intervals for performance criterion values, which help to determine whether the differences in performances between two hydrological models may be due to sampling variation. The jackknife statistic is a refinement of methods of direct assessment of sample variability and is based on the subdivision of the sample into a number of subsamples and the estimation of the desired statistic is made by combining the overall estimate of the statistic with the estimates obtained by omitting each subsample. A plot of the jackknife estimates of the overall criterion values against the jackknife estimates of their standard deviation helps to evaluate the performances of the models according to the relative importance of the overall criterion values and their standard deviation. The method was applied to the results of the recent World Meteorological Organization project for the intercomparison of conceptual models of snowmelt runoff. (Miller-PTT)
W89-01143

PROBLEMS OF RAINFALL-RUNOFF MODELLING IN ARID AND SEMIARID REGIONS,
New South Wales Univ., Kensington (Australia). School of Civil Engineering.
D. H. Pilgrim, T. G. Chapman, and D. G. Doran.
Hydrological Sciences Journal HSJODN, Vol. 33, No. 4, p 379-400, August 1988. 1 fig, 2 tab, 69 ref.

Descriptors: *Runoff forecasting, *Rainfall-runoff relationships, *Model studies, *Arid climates, *Semiarid climates, Rainfall, Streams.

The general characteristics of arid zone hydrological processes and the problems that they represent in runoff modeling are discussed. Both sloping lands with integrated stream networks and flat-lands with repetitive micro-hydrology are considered. The wide diversity in some characteristics may require different parameter values and possibly different approaches in different regions. Lack of observed data provides the major problem for runoff modelling in arid regions. Appropriate approaches to modelling for sloping regions including discrete event models and continuous models are discussed. (Miller-PTT)
W89-01144

ANNUAL ELEMENTAL INPUT/OUTPUT ESTIMATES FOR TWO FORESTED WATERSHEDS IN EASTERN TENNESSEE,
Tennessee Valley Authority, Oak Ridge.
For primary bibliographic entry see Field 5B.
W89-01168

ECOLOGY OF FRESHWATER GASTROPODS IN THE CENTRAL CANADIAN REGION,
Winnipeg Univ. (Manitoba). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W89-01183

STUDIES ON EPILITHIC AND EPIPHYTIC DIATOMS IN A CHALKSTREAM: COMPARATIVE ESTIMATES OF CHLOROPHYLL A AND ITS DERIVATIVES,
Freshwater Biological Association, Wareham (England). River Lab.
For primary bibliographic entry see Field 2H.
W89-01186

RELEASE OF MICRO-ALGAL PHOTOSYNTHATE AND ASSOCIATED BACTERIAL UPTAKE AND HETEROTROPHIC GROWTH,
University Coll. of Wales, Aberystwyth. Dept. of Botany and Microbiology.
For primary bibliographic entry see Field 2H.
W89-01187

APPLICATION OF PROBABILITY WEIGHTED MOMENTS IN ESTIMATING THE PARAMETERS OF THE PEARSON TYPE THREE DISTRIBUTION,
Nanjing Hydrological Research Inst. (China).
For primary bibliographic entry see Field 7C.
W89-01198

DETERMINATION OF PROBABILITY WEIGHTED MOMENTS WITH THE INCORPORATION OF EXTRAORDINARY VALUES INTO SAMPLE DATA AND THEIR APPLICATION TO ESTIMATING PARAMETERS FOR THE PEARSON TYPE THREE DISTRIBUTION,
Chengdu Univ. of Science and Technology (China).

For primary bibliographic entry see Field 7C.
W89-01199

RUNOFF GENERATION IN A LOW ARCTIC DRAINAGE BASIN,
York Univ., North York (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 2A.
W89-01207

RELATIONSHIP BETWEEN GLACIAL GEOLOGY AND STREAMWATER CHEMISTRY IN AN AREA RECEIVING ACID DEPOSITION,
State Univ. of New York at Buffalo. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5B.
W89-01210

SEDIMENT TRANSPORT OF THE GODAVARI RIVER BASIN AND ITS CONTROLLING FACTORS,
Jawaharlal Nehru Univ., New Delhi (India). School of Environmental Sciences.
For primary bibliographic entry see Field 2J.
W89-01211

WATER RESOURCES, SALINITY AND SALT YIELDS OF THE RIVERS OF THE BOLIVIAN AMAZON,
M. A. Roche, and C. F. Jauregui.
Journal of Hydrology JHYDA7, Vol. 101, No. 1-4, p 305-331, June 30, 1988. 12 fig, 3 tab, 33 ref.

Descriptors: *Water yield, *Water quality, *Bolivia, *Water resources development, *Madera River, *Amazon River, Salts, Dissolved solids, Ions, Discharge capacity, Precipitation, Salinity.

This study represents the first time that the water resources, the salinity, and the yields of the upper basins of the Madera River have been reported. Formed by the confluence of the Beni and Mamore, the Madera is one of the world's largest rivers: 17,000 cu m/sec, approximately half the discharge of the Congo River. It has a dissolved discharge close to that of the Congo River: 1 ton/sec of ions. Likewise, the Beni and the Mamore Rivers, are also classified as large rivers, greater than the Volga River, the largest in Europe, and the Niger River, the second largest in Africa. The amounts of water involved are considerable. The average dissolved content of these rivers, 57-61 mg/l respectively, is relatively low to medium. Many types of water, classified according to their ionic compositions, have been characterized in the Andes, the Amazon Plain, and in the main drainage axis. The slightly mineralized black water of the plain seems the most unique type. Recycling of water vapor in the Amazon Basin is confirmed by the low chloride and sodium contents of the water in the plain. Thus the importance of this phenomenon in the genesis of rainfall throughout the basin is emphasized. The contribution of the Upper Madera River to the Amazon River is 9.7% of the water and 10.9% of ionic load. (Author's abstract)
W89-01213

MODELING BLUE-GREEN ALGAL BLOOMS IN THE LOWER NEUSE RIVER,
Virginia Univ., Charlottesville. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5C.
W89-01225

VALUE OF STOCHASTIC STREAMFLOW MODELS IN OVERYEAR RESERVOIR DESIGN APPLICATIONS,
R. M. Vogel, and J. R. Stedinger.
Water Resources Research WRERAO, Vol. 24, No. 9, p 1483-1490, September 1988. 5 fig, 5 tab, 42 ref. NSF Grant ECE-8351819.

Descriptors: *Streamflow, *Reservoir design, *Model studies, *Stochastic hydrology, *Water yield, Storage capacity, Hydrologic data collections, Regression analysis, Estimation, Storage requirements, Hydrologic models, Variability, Reservoir yield.

The variability of required reservoir storage capacity estimates based on 20-year to 80-year streamflow records was examined. An autoregressive--AR(1)--lognormal model was 'fit' to 'historical' flow sequences generated with four different stochastic streamflow models: AR(1) lognormal, AR(1) normal, AR(1) gamma, and an AR-moving-average(1,1) lognormal model. These experiments documented the sampling variabilities of estimators of required capacity quantiles derived with stochastic streamflow models, as well as from use of the historical streamflow record alone. In general, fitting an AR(1) lognormal model led to more precise estimates of annual storage requirements than if only the historical flows was employed, even in situations when the flows were not generated with an AR(1) lognormal model. However, even required-capacity estimates obtained by fitting stochastic annual streamflow models to 80-year samples can be highly variable. Recognition of the variability of reservoir storage capacity, yield, and reliability estimates is important within the context of typical reservoir system-design applications. Such a realization may lead to the incorporation of uncertainty into the analysis. Arguments over which stochastic streamflow-model structure to employ in a given application appear to be moot within the context of the overall problem of estimating the reservoir-system storage/reliability/yield relationship. (Shidler-PTT)
W89-01244

IMPACT OF RAINFALL AND SOIL HYDRAULIC PROPERTY INFORMATION ON RUNOFF PREDICTIONS AT THE HILLSLOPE SCALE,
Hawaii Univ. at Manoa, Honolulu. Dept. of Geology and Geophysics.
K. M. Loague.
Water Resources Research WRERAO, Vol. 24, No. 9, p 1501-1510, September 1988. 6 fig, 4 tab, 8 ref.

Descriptors: *Runoff forecasting, *Rainfall, *Soil properties, *Hydraulic properties, *Slopes, *Rainfall-runoff relationships, Model studies, Spatial distribution, Storm runoff.

The stochastic/conceptual model designed to investigate rainfall/runoff processes on a hillslope was modified to examine the impact of hydrologic data in simulating rainfall/runoff events. Analysis of almost 12,000 synthesized rainfall/runoff events generally shows that the spatial description of soil hydraulic properties has a greater impact on the characterization of hillslope runoff than corresponding descriptions of rainfall. Estimates of peak storm flow and time to peak were found to be less accurate than estimates of storm-flow depth for the same level of information illustrating that different levels of information may be required to make predictions of equal efficiency for different summary variables. (Author's abstract)
W89-01246

CHEMICAL EVOLUTION OF A TRAVERTINE-DEPOSITING STREAM: GEOCHEMICAL PROCESSES AND MASS TRANSFER REACTIONS,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 2K.
W89-01250

2F. Groundwater

DEVELOPMENT OF MICROORGANISMS ON THE BACKGROUND OF ORGANIC MATTER IN FOREST ECOSYSTEM WATERS,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 2H.
W89-00080

ESKER AQUIFERS,
Caswell, Eichler and Hill, Inc., West Topsham, VT.
For primary bibliographic entry see Field 4B.
W89-00264

PREDICTION OF RAINBOW TROUT EMBRYO SURVIVAL IN RELATION TO GROUNDWATER SEEPAGE AND PARTICLE SIZE OF SPAWNING SUBSTRATES,
Waterloo Univ. (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W89-00326

MICROBIAL BIOMASS, ACTIVITY, AND COMMUNITY STRUCTURE OF WATER AND PARTICULATES RETRIEVED BY BACKFLOW FROM A WATERFLOOD INJECTION WELL,
Calgary Univ. (Alberta). Dept. of Biology.
For primary bibliographic entry see Field 5B.
W89-00334

STORM RESPONSE OF THE KARSTIC CARBONATE AQUIFER OF SOUTHCENTRAL KENTUCKY,
Nevada Univ. System, Las Vegas. Water Resources Center.
For primary bibliographic entry see Field 2A.
W89-00349

VALIDITY OF THE ENVIRONMENTAL CHLORIDE METHOD FOR RECHARGE EVALUATION OF COASTAL AQUIFERS, INDIA.
National Geophysical Research Inst., Hyderabad (India).
For primary bibliographic entry see Field 7B.
W89-00356

MODELLING OF FLOW THROUGH POTASH TAILINGS PILES,
Saskatchewan Univ., Saskatoon. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-00388

REGIONAL HYDROGEOLOGY OF AGRICULTURAL DRAINAGE WELLS IN IOWA,
Iowa Univ., Iowa City. Dept. of Geology.
For primary bibliographic entry see Field 5B.
W89-00471

HYDROGEOLOGICAL AND HYDROGEOCHEMICAL STUDIES OF THE UNSATURATED FLOW IN A GRAVEL AQUIFER: PART II. RESULTS OF LONG TERM SOIL-HYDROLOGICAL MEASUREMENTS (HYDROGEOLOGISCHE UND HYDROCHEMISCHE UNTERSUCHUNGEN IN DER UNGESAETTIGTEN ZONE EINES KIESGRUNDWASSERLEITERS: TEIL II. ERGEBNISSE LANGJAEHRIGER BODENHYDROLOGISCHER MESSUNGEN),
Technische Univ., Munich (Germany, F.R.). Lehrstuhl fuer Hydrogeologie and Hydrochemie.
I. Ullsperger, B. Merkel, K.-E. Quentin, and P. Udluft.
Zeitschrift fuer Wasser und Abwasser-Forschung ZWABAQ, Vol. 21, No. 2, p 56-66, April 1988. 16 fig, 8 tab, 10 ref.

Descriptors: *Aquifers, *Groundwater movement, *Flow, *Geohydrology, *Soil water, *Unsaturated Flow, Seepage, Physicochemical properties, Precipitation, Relative humidity, Air temperature, Soil temperature, Capillary conductivity, Groundwater recharge, Tracers, Mathematical models, Geochemistry.

An accessible research shaft was built in 1981 at the Department for Hydrogeology and Hydrochemistry of the Technical University, Munich, West Germany to enable investigations of physicochemical processes. Soil temperature and capillary pressure head at seven depths in the unsaturated zone of 12 m were monitored along with precipitation, groundwater level, relative humidity and air temperature. To determine seepage velocity, a tracer field experiment was carried out. The uranin and eosin fluorescent tracers gave unsatisfactory results, but tritium was a good tracer for the unsaturated zone. The results of a five year period of measurement are presented and discussed. Water

contents and unsaturated conductivity as well as the groundwater recharge were calculated by model functions, which are based on laboratory experiments and the measured hydraulic head. (Author's abstract)
W89-00503

BORON LEVELS IN SOME GROUND WATERS OF HALKIDIKI (A LAND AT NORTHERN AEGEAN SEA),
Thessaloniki Univ., Salonika (Greece). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-00569

ANALYSIS OF ATRAZINE IN UNDERGROUND WATERS AT PART PER TRILLION LEVELS AS AN EARLY WARNING METHOD FOR CONTAMINATION AND FOR SOIL DISTRIBUTION STUDIES,
Istituto di Ricerche Farmacologiche Mario Negri, Milan (Italy). Lab. of Environmental Pharmacology and Toxicology.
For primary bibliographic entry see Field 5A.
W89-00596

CREOSOTE COMPOUNDS IN SNAILS OBTAINED FROM PENSACOLA BAY, FLORIDA, NEAR AN ONSHORE HAZARDOUS-WASTE SITE,
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 5B.
W89-00611

IRON OXIDE FORMATION IN ARTIFICIAL GROUND WATERS,
Technische Univ. Muenchen (Germany, F.R.). Lehrstuhl fuer Bodenkunde.
U. Schwertmann, L. Carlson, and H. Fechter.
Schweizerische Zeitschrift fuer Hydrologie SZHYA6, Vol. 46, No. 2, p 185-191, June 1984. 2 fig, 1 tab, 13 ref.

Descriptors: *Iron oxides, *Oxides, *Oxidation, *Chemical precipitation, *Minerals, *Groundwater pollution, *Groundwater, Iron, Silicon, Chemical properties, Aeration zone, Artificial groundwater.

To simulate the Fe-oxide formation from Fe(II)-containing ground waters on rapid aeration, artificial ground water containing 40 mg/l Ca and varying concentrations of Fe(II), Fe(III) and Si were rapidly oxidized with air at room temperature. The Fe-oxide formed in the Fe(II)-system was a poorly crystalline lepidocrocite at Si concentrations < 4 mg/l Si and a 2-3 line ferrihydrite at higher Si concentrations. The ferrihydrite is similar in color, x-ray diffraction, IR absorption and chemical composition to those found in natural Finnish ground waters of similar composition. In contrast to Si, organics (1-20 mg/l C) from a hot water soil extract only reduced the crystallinity of lepidocrocite, but did not induce ferrihydrite formation. (Author's abstract)
W89-00687

DISPERSION IN HETEROGENEOUS POROUS MEDIA: 1. LOCAL VOLUME AVERAGING AND LARGE-SCALE AVERAGING,
Washington State Univ., Pullman. Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 5B.
W89-00699

DISPERSION IN HETEROGENEOUS POROUS MEDIA: 2. PREDICTIONS FOR STRATIFIED AND TWO-DIMENSIONAL SPATIALLY PERIODIC SYSTEMS,
Washington State Univ., Pullman. Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 5B.
W89-00700

SINGLE-WELL TRACING METHOD FOR ESTIMATING REGIONAL ADVECTIVE VELOCITY IN A CONFINED AQUIFER: THEORY AND PRELIMINARY LABORATORY VERIFICATION,
Purdue Univ., Lafayette, IN. Dept. of Earth and Atmospheric Sciences.
D. I. Leap, and P. G. Kaplan.
Water Resources Research WRERAO, Vol. 24, No. 7, p 993-998, July 1988. 4 fig, 1 tab, 13 ref. DOI Grants 14-08-0001-G841 and 14-08-0001-G905.

Descriptors: *Mathematical studies, *Confined aquifers, *Groundwater movement, Solute transport, Pumping tests, Performance evaluation, Spatial distribution, Single-well tracer test, Regional advective velocity.

An equation is derived by which advective groundwater velocity in a confined aquifer may be estimated by a single-well tracer test in which a single tracer pulse is allowed to drift from the well and then pumped backed to the well and sampled to obtain a breakthrough curve. Although similar in methodology to preexisting methods, this method differs in that it takes into account ambient groundwater movement during the pumpback phase. Using sodium chloride as a tracer solution, a series of small-scale tests were run in a laboratory sand tank model to test the theory. Results of linear flow tracer tests through the model, simulating unperturbed regional advective flow at known velocities, were compared to results of single-well drift-and-pumpback tests conducted during linear flow through the model. Advective velocities computed by both types of tests were identical, thus proving the validity of the equation. (Author's abstract)
W89-00707

GROUNDWATER FLOW SYSTEMS IN MOUNTAINOUS TERRAIN: 1. NUMERICAL MODELING TECHNIQUE,
Utah State Univ., Logan. Dept. of Geology.
C. Forster, and L. Smith.
Water Resources Research WRERAO, Vol. 24, No. 7, p 999-1010, July 1988. 5 fig, 2 tab, 44 ref.

Descriptors: *Mathematical models, *Groundwater movement, *Mountains, *Temperature effects, Numerical anlaysis, Heat transfer, Temperatures, Water table, Free surfaces.

A coupled model of fluid flow and heat transfer is developed to characterize steady groundwater flow within a mountain massif. A coupled model is necessary because high-relief terrain can enhance groundwater flow to depths where elevated temperatures are encountered. A wide range in water table form and elevation expected in high-relief terrain is accomodated using a free-surface method. This approach allows the examination of the influence of thermal conditions on the patterns and rates of groundwater flow and the position of the water table. Vertical fluid flow is assumed to occur within the unsaturated zone to provide a simple basis for modeling advective heat transfer above the water table. This approach ensures that temperatures at the water table, and throughout the domain, are consistent with temperature conditions specified at the bedrock surface. Conventional free-surface methods provide poor estimates of the water table configuration in high-relief terrain. A modified free-surface approach is introduced to accomodate recharge at upper elevations on the seepage face, in addition to recharge at the free surface. (See also W89-00709) (Author's abstract)
W89-00708

GROUNDWATER FLOW SYSTEMS IN MOUNTAINOUS TERRAIN: 2. CONTROLLING FACTORS,
Utah State Univ., Logan. Dept. of Geology.
C. Forster, and L. Smith.
Water Resources Research WRERAO, Vol. 24, No. 7, p 1011-1023, July 1988. 11 fig, 3 tab, 12 ref.

Descriptors: *Geohydrology, *Mathematical models, *Groundwater movement, *Mountains, *Temperature effects, Water table fluctuations, Topography, Relief, Permeability, Thermal conductivity, Glaciers, Temperature, Infiltration, Geologic fractures.

The modeling technique developed in part 1 of this 2-part study provides a quantitative means for assessing the impact of factors controlling groundwater flow systems in mountainous terrain. Conditions examined include surface topography (slope profile, relief, 3-dimensional form), geology (permeability and thermal conductivity), climate available infiltration, presence and extent of alpine glaciers, surface temperature conditions), and regional heat flux. Water table elevation is a sensitive indicator of the factors controlling mountain flow systems. Under certain conditions, overestimating the bulk permeability of a mountain massif by a factor of 5 can lead to underestimates of the water table elevation in excess of 1000 m. Under the same conditions, rates of fluid flux may be overestimated by at least 60%. The infiltration rate, regional heat flux, and the presence of glaciers have important, but lesser impacts. High topographic relief amplifies the influence of surface topography and permeable fracture zones on patterns of groundwater flow and on the position of groundwater flow divides. Although computed water table elevations are sensitive to controlling factors, uncertainties inherent in resolving the magnitude of many of the controlling parameters will complicate efforts to constrain simulations using measured water table elevations. (See also W89-00708) (Author's abstract)
W89-00709

DISTRIBUTED PARAMETER APPROACH FOR EVALUATING THE ACCURACY OF GROUNDWATER MODEL PREDICTIONS: 1. THEORY,
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab.
D. McLaughlin, and E. Wood.
Water Resources Research WRERAO, Vol. 24, No. 7, p 1037-1047, July 1988. 2 fig, 41 ref, append. NSF Grant ECE-8514987.

Descriptors: *Stochastic models, *Groundwater movement, *Model studies, *Mathematical models, *Stochastic hydrology, Distributed parameter approach, Performance evaluation, Prediction, Errors, Mathematical equations, Sampling design.

A systematic stochastic analysis suggests that groundwater model accuracy depends on natural heterogeneity, data availability, model approximations, and a method used to develop a description of the modeling process which includes all of these factors. This description is based on a set of hybrid state equations which clearly distinguish between the heterogeneous distributed variables of the natural (reference) system and the aggregated variables of the discretized model. Approximate expressions for the first and second moments of the model's prediction error are derived directly from the state equations. The derived moments provide a convenient way to examine a number of questions related to sampling design, robust input estimation, and model performance. They also may be used to design modeling studies before extensive resources are committed to data collection and model development. (See also W89-00712) (Author's abstract)
W89-00711

DISTRIBUTED PARAMETER APPROACH FOR EVALUATING THE ACCURACY OF GROUNDWATER MODEL PREDICTIONS: 2. APPLICATION TO GROUNDWATER FLOW,
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab.
D. McLaughlin, and E. Wood.
Water Resources Research WRERAO, Vol. 24, No. 7, p 1048-1060, July 1988. 9 fig, 3 tab, 37 ref. NSF Grant ECE-8514987.

Descriptors: *Stochastic hydrology, *Mathematical models, *Stochastic models, *Groundwater movement, Distributed parameter approach, Performance evaluation, Prediction, Errors, Dimensional analysis.

The distributed parameter theory is used to evaluate the accuracy of a groundwater flow model. The special case investigated assumes that the model's prediction errors are due primarily to data

limitations. In this case, approximate prediction error moments (mean and covariance) are obtained by solving two sets of coupled partial differential equations which have the same basic structure as the original flow equation. Solutions can be obtained with spectral, Green's function, or numerical techniques, depending on the assumptions made. Two examples are solved using a finite element approach. The first (2-dimensional) example confirms steady state infinite domain results obtained with spectral methods. The second (3-dimensional) example investigates the influence of spatial variability, sampling strategy, and suboptimal estimation on model prediction accuracy. (See also W89-00711) (Author's abstract)
W89-00712

THREE-DIMENSIONAL RADIAL DISPERSION IN A VARIABLE VELOCITY FLOW FIELD,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 5B.
W89-00715

MICROSCALE HALINE CONVECTION - A PROPOSED MECHANISM FOR TRANSPORT AND MIXING AT THE WATER TABLE REGION,
Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.
D. Ronen, M. Magaritz, and N. Paldor.
Water Resources Research WRERAO, Vol. 24, No. 7, p 1111-1117, July 1988. 9 fig, 37 ref.

Descriptors: *Irrigation effects, *Path of pollutants, *Solute transport, *Saline water, *Unconfined aquifers, *Convection, *Groundwater movement, Microscale haline convection, Transport, Mixing, Israel.

Field measurements of chloride profiles in the water table region of a deep aquifer (Israel Coastal Plain) are interpreted in terms of haline convection at the microscale level. Under natural flow conditions the flow field is characterized by a small Peclet number (between 0.0625 and 0.00625) so that molecular diffusion dominates over mechanical dispersion. Haline convection apparently is a major transport and mixing mechanism at the water table region of granular aquifers under natural flow conditions wherever the intervention of man changed the chemical composition of natural replenishment. In the studied region it is estimated that the critical density difference which overcomes viscous drag forces is 0.23-0.28 kg/cu m. This value agrees with the magnitude of the critical free convection parameter (modified Rayleigh number) of earlier models. (Author's abstract)
W89-00718

DRY STREAM REACHES IN CARBONATE TERRANES: SURFACE INDICATORS OF GROUND-WATER RESERVOIRS,
Geological Survey, Nashville, TN.
For primary bibliographic entry see Field 7B.
W89-00870

SIMULATION OF REGIONAL GROUND WATER FLOW IN BEDROCK, SOUTHWESTERN NEW YORK-NORTHWESTERN PENNSYLVANIA,
Stearns and Wheeler, Cazenovia, NY.
G. Gould, and D. I. Siegel.
Water Resources Bulletin WARBAQ, Vol. 24, No. 3, p 671-676, June 1988. 4 fig, 1 tab, 27 ref. American Chemical Society Petroleum Research Fund Grant 17339-AC2.

Descriptors: *Simulation analysis, *Bedrock, *New York, *Pennsylvania, *Groundwater movement, *Geohydrolgoy, *Model studies, Regional analysis, Hydrologic models, Computer models.

This paper presents the results of steady-state three-dimensional computer simulations to determine the hydrogeologic setting of formation water in the hydrocarbon producing formations of southwestern New York and northwestern Pennsylvania. Recharge areas for the regional ground water flow systems in the study area are the Valley Heads Moraine and Allegheny uplands; discharge areas are Lakes Erie and Ontario to the north and the northern margin of the Appalachian basin to the south. Simulated ground water flow in all model layers moves north from the ground water divide on the Valley Heads Moraine towards Lake Erie at a rate from .000001 to .001 ft/day. South of the divide intermediate-scale and local-scale flow systems occur in the upper 4000 feet of the stratigraphic section and the directions of ground water flow diverge towards major rivers and other topographically low areas. (Author's abstract)
W89-00882

MICROBIAL POLLUTION OF WELL WATER IN SOUTHEASTERN MINNESOTA,
Minnesota Univ., St. Paul. Coll. of Veterinary Medicine.
For primary bibliographic entry see Field 5B.
W89-00887

BASIC ENCODED MODEL FOR ONE-DIMENSIONAL GROUND WATER SYSTEMS INCORPORATING FIRST-ORDER DEGRADATION KINETICS,
Cook Coll., New Brunswick, NJ. Dept. of Environmental Science.
For primary bibliographic entry see Field 5B.
W89-00888

CHEMISTRY AND DELTA 13C OF TOTAL DISSOLVED CARBON IN WATERS OF SELECTED SPRINGS NEARBY LUBLIN CITY: WEEKLY OBSERVATIONS FROM OCTOBER 1982 TO JUNE 1983,
Marie Curie-Sklodowska Univ., Lublin (Poland).
P. Staniaszek, and S. Halas.
Nordic Hydrology NOHYBB, Vol. 19, No. 2, p 121-134, 1988. 7 fig, 3 tab, 23 ref.

Descriptors: *Isotope studies, *Stable isotopes, *Spring water, *Groundwater, *Chemical analysis, *Chemical properties, Seasonal variation, Hydrogen ion concentration, Mixing, Calcium, Magnesium, Carbonate rocks, Carbon, Poland, Aquifers.

Seasonal changes of (13C)/(12C) ratios and chemistry of ground waters were studied. When new waters are mixed with the aquifer water, changes of its parameters are anticipated. These changes are small but detectable, because the aquifer content is large in comparison to the amount of new water. Sometimes, non-linearities in the mixing effects magnify these changes. Since the aquifer is not homogeneous, the changes of parameters of water taken from the springs are multidirectional and irregular. Chemistry and delta(13C) of total dissolved carbon and HCO3(-), Ca(++), and Ca(++) + Mg(++) contents in spring waters were investigated. Changes of these values were recorded for eight months of 1982 and 1983. The changes were irregular and larger in winter and early spring, than in autumn and late spring. These changes and a long-term trend observed in October and November are discussed in terms of models and the theory of mixing of waters. (Ver-Nooy-PTT)
W89-00895

GROUNDWATER VELOCITY MAGNITUDE IN RADIONUCLIDE TRANSPORT CALCULATIONS,
For primary bibliographic entry see Field 5B.
W89-00903

FINITE ELEMENT COMPUTATION OF SHAPE FACTORS FOR KIRKHAM'S PIEZOMETER TUBE METHOD FOR HYDRAULIC CONDUCTIVITY OF SATURATED SOIL,
Dundee Univ. (Scotland). Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 2G.
W89-00911

GROUNDWATER RECHARGE IN ARID REGIONS: REVIEW AND CRITIQUE OF ESTIMATION METHODS,
Battelle Pacific Northwest Labs., Richland, WA.
G. W. Gee, and D. Hillel.
Hydrological Processes HYPRE3, Vol. 2, No. 3, p 255-266, July-September 1988. 59 ref. Dept. of Energy Contract DE-AC06-76RLO 1830.

Descriptors: *Groundwater recharge, *Arid lands, *Arid-zone hydrology, *Hydrologic budget, *Literature review, Recharge, Evapotranspiration, Estimating, Isotopic tracers, Lysimeters.

Arid-site recharge, while generally low, can be highly variable. Recharge under similar climate and soil conditions but with different plant cover and topography can vary from zero to more than the annual precipitation. Simple estimates of recharge based on fixed fractions of annual precipitation are misleading because they do not reflect the plant and soil factors controlling recharge. Detailed water balance models, successful for irrigated agriculture, fail to predict evapotranspiration accurately under conditions where plants suffer seasonal water stress and cover is sparse. Recharge, when estimated as a residual in water balance models, may be in error by as much as an order of magnitude. Similar errors can occur when soil water flow models are used with measured or estimated soil hydraulic conductivities and tension gradients. Lysimetry and tracer tests offer the best hope for evaluating recharge at arid sites, particularly in siting waste disposal facilities, where reliable recharge estimates are needed. Quantification of drainage using lysimetry over several years under a given set of soil, plant, and climate conditions for a specific site can provide a basis for calibrating models for recharge prediction. Tracer tests using such long-lived tracers as 36Cl or perhaps stable isotopes (18oxygen, deuterium) can provide qualitative estimates of recent recharge at a given site. (Author's abstract)
W89-00914

DEFINITION OF A MODEL FOR MONITORING THE CHEMICAL AND CHEMICAL-PHYSICAL CHARACTERISTICS OF DEEP DRINKING WATERS,
Perugia Univ. (Italy). Cattedra di Igiene.
For primary bibliographic entry see Field 7C.
W89-00927

THERE'S NO SUCH THING AS A REPRESENTATIVE GROUND WATER SAMPLE,
Leggette, Brashears and Graham, Inc., St. Paul, MN.
For primary bibliographic entry see Field 5A.
W89-00937

MAKING THE MOST OF FIELD-MEASURABLE GROUND WATER QUALITY PARAMETERS,
Hydrolab Corp., Austin, TX.
For primary bibliographic entry see Field 7B.
W89-00939

TRACER TEST ANALYSIS OF ANISOTROPY IN HYDRAULIC CONDUCTIVITY OF GRANULAR AQUIFERS,
Wright State Univ., Dayton, OH. Dept. of Geological Science.
G. J. Kenoyer.
Ground Water Monitoring Review GWMRDU, Vol. 8, No. 3, p 67-70, Summer 1988. 2 fig, 1 tab, 14 ref.

Descriptors: *Hydraulic conductivity, *Anisotropy, *Aquifers, *Piezometers, *Groundwater movement, *Tracers, Hydraulic gradient.

A simple method was developed to determine anisotropy ratio of hydraulic conductivity in near-surface granular aquifers using a tracer test and piezometer measurements. Depending on the length of time allowed, the test will yield anisotropy ratios that are representative of the distance traversed by the tracer during the test, up to tons

of feet from the injection point for some systems. The method is illustrated with an application to a groundwater flow system in northern Wisconsin. (Author's abstract)
W89-00940

OXYGEN TRANSFER THROUGH FLEXIBLE TUBING AND ITS EFFECTS ON GROUND WATER SAMPLING RESULTS,
Illinois State Water Survey Div., Champaign. Aquatic Chemistry Section.
For primary bibliographic entry see Field 5A.
W89-00943

CONTAMINATION OF FARMSTEAD WELLS BY PESTICIDES, VOLATILE ORGANICS, AND INORGANIC CHEMICALS IN KANSAS,
Kansas State Univ., Manhattan. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5B.
W89-00946

CONTINUUM MODELS FOR CONTAMINANT TRANSPORT IN FRACTURED POROUS FORMATIONS,
Technion - Israel Inst. of Tech., Haifa. Faculty of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-00966

NONAQUEOUS PHASE LIQUID TRANSPORT AND CLEANUP: I. ANALYSIS OF MECHANISMS,
California Univ., Berkeley. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-00968

NONAQUEOUS PHASE LIQUID TRANSPORT AND CLEANUP: II. EXPERIMENTAL STUDIES,
California Univ., Berkeley. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-00969

COMPARISON OF TWO METHODS FOR SUMMARIZING HYDRAULIC CONDUCTIVITIES OF A LAYERED SOIL,
Kansas State Univ., Manhattan. Dept. of Agronomy.
For primary bibliographic entry see Field 2G.
W89-00970

METHOD FOR LOCATING WELLS IN A GROUNDWATER MONITORING NETWORK UNDER CONDITIONS OF UNCERTAINTY,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7A.
W89-00971

ANALYTICAL SOLUTION FOR AQUIFER DECONTAMINATION BY PUMPING,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
For primary bibliographic entry see Field 5G.
W89-00977

MANAGEMENT OF A TRIBUTARY AQUIFER,
New Mexico Univ., Albuquerque. Dept. of Economics.
For primary bibliographic entry see Field 4B.
W89-00978

CONTINUUM APPROACH FOR MODELING MASS TRANSPORT IN FRACTURED MEDIA,
Alberta Univ., Edmonton. Dept. of Geology.
For primary bibliographic entry see Field 5B.
W89-00980

CONTAMINANT TRANSPORT IN FRACTURED POROUS MEDIA: STEADY STATE SOLUTIONS BY A BOUNDARY INTEGRAL METHOD,
Melbourne Univ., Parkville (Australia). Dept. of Mathematics.
For primary bibliographic entry see Field 5B.
W89-00982

FOG DRIP AS A SOURCE OF GROUNDWATER RECHARGE IN NORTHERN KENYA,
California Univ., Davis. Dept. of Geology.
N. L. Ingraham, and R. A. Matthews.
Water Resources Research WRERAO, Vol. 24, No. 8, p 1406-1410, August 1988. 2 fig, 1 tab, 20 ref.

Descriptors: *Precipitation, *Groundwater recharge, *Fog, *Atmospheric water, *Infiltration, *Mist, *Kenya, Air-earth interfaces, Geohydrology, Surface-groundwater relations, Statistical analysis, Radioisotopes, Tracers, Rainfall, Percolation, Groundwater.

Fog drip, or mist precipitation, has generally been neglected by hydrogeologists as a source of water, largely because of the difficulty in tracing fog through the hydrosphere. In the arid climate of northern Kenya, light stable isotopes aided in assessing the importance of fog drip. Fog was collected at localized fog-laden montane areas and determined to have delta D values of about +3 to +16.6%. Rain-derived groundwater was found to have delta D values of about -25%. However, groundwater in the fog-laden areas have delta D values of about -12.5% and appear to be a mixture of fog and rain. It is thought that in special environments such as northern Kenya, fog drip may be an important source of infiltration and groundwater recharge. (Author's abstract)
W89-00984

DRAWDOWN INTERVAL ANALYSIS: A METHOD OF DETERMINING THE PARAMETERS OF SHALLOW CONDUIT FLOW CARBONATE AQUIFERS FROM PUMPING TESTS,
Kentucky Univ., Lexington. Dept. of Geology.
J. Thrailkill.
Water Resources Research WRERAO, Vol. 24, No. 8, p 1423-1428, August 1988. 5 fig, 3 tab, 16 ref.

Descriptors: *Karst hydrologyy, *Mathematical analysis, *Groundwater movement, *Drawdown, *Drawdown interval analysis, *Pumping tests, Groundwater, Aquifers, Simulation, Parametric hydrology, Conduits, Pumps, Mathematical studies, Mathematical equations, Diffusivity, Aquifer characteristics.

In shallow conduit flow (SCF) carbonate aquifers, the nature of the void space and groundwater flow differs from that of granular aquifers in that the voids are solution conduits, often of large size, and flow is generally non-Darcy. These and other characteristics of SCF aquifers preclude the application of pumping test analysis methods based on the diffusion equation. The drawdown interval analysis (DIA) method, which is consistent with a conceptual model of the SCF aquifer, provides estimates of aquifer parameters using both direct calculation and simulation approaches. Application of the DIA method to two wells yielded parameter values that are consistent with the hydrogeologic setting of the wells. (Author's abstract)
W89-00986

THEORETICAL ANALYSIS OF DEVIATIONS FROM LOCAL EQUILIBRIUM DURING SORBING SOLUTE TRANSPORT THROUGH IDEALIZED STRATIFIED AQUIFERS,
Illinois Univ., Urbana. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-00987

SORPTION NONEQUILIBRIUM DURING SOLUTE TRANSPORT,
Robert S. Kerr Environmental Research Lab., Ada, OK.
For primary bibliographic entry see Field 5B.
W89-00988

REACTOR ACCIDENT AT CHERNOBYL: A POSSIBILITY TO TEST COLLOID-CONTROLLED TRANSPORT OF RADIONUCLIDES IN A SHALLOW AQUIFER,
Bern Univ. (Switzerland). Radiochemisches Lab.
For primary bibliographic entry see Field 5B.
W89-00990

STATISTICAL CORRELATIONS FOR PREDICTING THE PARTITION COEFFICIENT FOR NONPOLAR ORGANIC CONTAMINANTS BETWEEN AQUIFER ORGANIC CARBON AND WATER,
General Motors Research Labs., Warren, MI. Environmental Science Dept.
For primary bibliographic entry see Field 5B.
W89-00992

MODELLING SOIL WATER DYNAMICS IN THE UNSATURATED ZONE: STATE OF THE ART,
Institute for Land and Water Management Research, Wageningen (Netherlands).
For primary bibliographic entry see Field 2G.
W89-01014

STATUS OF ISOTOPE HYDROLOGY TODAY,
For primary bibliographic entry see Field 2A.
W89-01018

GROUNDWATER FLOW AND TRANSPORT MODELING,
Geological Survey, Reston, VA.
L. F. Konikow, and J. W. Mercer.
Journal of Hydrology JHYDA7, Vol. 100, No. 1/3, p 379-409, July 30, 1988. 7 fig, 101 ref.

Descriptors: *Hydrology, *Groundwater movement, *Path of pollutants, *Solute transport, Powder River Basin, Wyoming, Montana, Aquifers, Chemical wastes, Industrial wastes, Hamilton, Ohio, Model studies, Mathematical models.

Deterministic, distributed-parameter, numerical simulation models for analyzing groundwater flow and transport problems are in common use. The theoretical basis and practical use of groundwater flow and solute transport models are presented. For flow modeling, data are generally sufficient to allow calibration of the model. For solute-transport modeling, lack of data not only limits calibration, but also causes uncertainty in process description. Where data are available, model reliability should be assessed on the basis of sensitivity tests and measures of goodness-of-fit. Two case histories are given. The first involves the effects of groundwater withdrawals from a deep regional aquifer for use in the proposed Powder River Basin, Wyoming-Montana, coal slurry pipeline (15,000 to 20,000 acre-ft/yr water required). A variety of models were used to predict the drawdowns. The second case history involves a ten-acre site impacted by chemical recycling activities in Hamilton, Ohio. Thousands of leaking drums and 300,00 gal of bulk hazardous materials were present at the time of closure in 1980. The facility overlay a large, productive aquifer. Volatile organic compounds, the most mobile materials, were chosen for studies of pollutant migration and for development of a remediation plan. (Cassar-PTT)
W89-01025

TRANSPORT OF SOLUTES IN SOILS AND AQUIFERS,
Agricultural Univ., Wageningen (Netherlands). Dept. of Land and Water Use.
For primary bibliographic entry see Field 5B.
W89-01027

CONTAMINANT HYDROGEOLOGY DOLLARS AND SENSE,
Alberta Univ., Edmonton. Dept. of Geology.

For primary bibliographic entry see Field 5B.
W89-01028

AEROBIC BIODEGRADATION OF NATURAL AND XENOBIOTIC ORGANIC COMPOUNDS BY SUBSURFACE MICROBIAL COMMUNITIES,
North Carolina Univ., Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5B.
W89-01090

RADIONUCLIDES IN DRINKING WATER,
Maine Univ., Orono. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-01104

OCCURRENCE OF RADON IN WELL SUPPLIES,
American Water Works Service Co., Voorhees, NJ. System Water Quality Dept.
For primary bibliographic entry see Field 5B.
W89-01105

OPERATING A SMALL FULL-SCALE ION EXCHANGE SYSTEM FOR URANIUM REMOVAL,
Arber (Richard P.) Associates, Inc., Denver, CO.
For primary bibliographic entry see Field 5F.
W89-01107

OCCURRENCE OF RADON, RADIUM, AND URANIUM IN GROUNDWATER,
Environmental Protection Agency, Cincinnati, OH.
For primary bibliographic entry see Field 5B.
W89-01108

EVALUATING VARIOUS ADSORBENTS AND MEMBRANES FOR REMOVING RADIUM FROM GROUNDWATER,
Houston Univ., TX. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5F.
W89-01109

METHODS FOR REMOVING URANIUM FROM DRINKING WATER,
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
For primary bibliographic entry see Field 5F.
W89-01110

MODALP: A DETERMINISTIC RAINFALL-RUNOFF MODEL FOR LARGE KARSTIC AREAS,
Hacettepe Univ., Ankara (Turkey). Dept. of Hydrogeological Engineering.
A. Arikan.
Hydrological Sciences Journal HSJODN, Vol. 33, No. 4, p 401-414, August 1988. 6 fig, 2 tab, 10 ref.

Descriptors: *Model studies, *Groundwater, *Rainfall-runoff relationships, *Aquifers, *Karst hydrology, *Turkey, Basins, Soil properties, Base flow.

A model has been developed for fractured-fissured and karstic aquifers that consists of two main systems: (1) one which represents the surface drainage area and simulates the peak flows of the hydrograph, and (2) one which simulates the inflows from the adjacent closed basins that contribute to the baseflow. Each of these two systems consists of two reservoirs. The first reservoir represents the soil cover and the unsaturated zone and its main function is to deliver the effective precipitation of the second reservoir. The second reservoir represents the saturated zone of the karst system. Since the intensity of karstification decreases with depth, a variable discharge coefficient is considered. The model has been successfully applied to the Manvgat River basin in Turkey which is a highly karstified area. (Author's abstract)
W89-01145

STABILITY OF SAND SLOPES IN THE GROUNDWATER DISCHARGE ZONES,
For primary bibliographic entry see Field 8D.
W89-01174

USE OF HYDROGEOCHEMICAL SAMPLING DATA IN HYDRAULIC ENGINEERING,
M. P. Leonov.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 9, p 542-547, September 1988. 2 tab, 9 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 9, p 36-39, September 1987.

Descriptors: *Groundwater origins, *Subsurface drainage, *Tracers, *Mixing, *Geohydrology, *Geochemistry, Soviet Union, Hydroelectric plants.

The problem of determining the quantitative relations of waters of different origin, recorded as a mixture in individual zones of the seepage region or at places of outflow in springs and drainage systems, is investigated. The results of calculations by mixing formulas are approximate and the accuracy of estimating the relationship of constituents in a mixture depends on the reliability of the hydrogeological calculation scheme used and initial characteristics of the subsurface waters. To increase the accuracy, performing parallel calculations with the use of different tracers are recommended. Ions, microcomponents, isotopes, total mineralization and, sometimes, water temperature, can be used as tracers for separating a mixture of various types of subsurface waters into components. Several examples of using mixing formulas for solving various problems are examined, including: (1) analysis of the conditions of formation of drainage waters of the Charvak Hydroelectric Station, and (2) analysis of inflow to the drainage devices of the tailrace channel of the Pplyavinyas Hydroelectric Station. The given examples, which are rather complex and unusual, indicate the effectiveness of using the described method. (Miller-PTT)
W89-01178

CITIES SUPPORTED BY STICKS IN THE MUD: A VARIATION ON THE SETTLEMENT OF LAND AND STRUCTURES CAUSED BY GROUND WATER REMOVAL,
For primary bibliographic entry see Field 6E.
W89-01190

GENERAL CORRECTION FOR SPONTANEOUS POTENTIAL WELL LOGS IN FRESH WATER,
Missouri Univ.-Rolla. Dept. of Geological Engineering.
For primary bibliographic entry see Field 7B.
W89-01195

PUMPING TESTS IN NONUNIFORM AQUIFERS: THE RADIALLY SYMMETRIC CASE,
Kansas State Geological Survey, Lawrence.
J. J. Butler.
Journal of Hydrology JHYDA7, Vol. 1-4, No. 104, p 15-30, June 30, 1988. 5 fig, 38 ref.

Descriptors: *Pumping tests, *Aquifer characteristics, *Groundwater movement, *Mathematical models, *Flow profiles, Numerical analysis, Drawdown, Thiems equation, Test wells.

Traditionally, pumping-test-analysis methodology has been limited to applications involving aquifers whose properties are assumed uniform in space. This work attempts to assess the applicability of analytical methodology to a broader class of units with spatially varying properties. An examination of flow behavior in a simple configuration consisting of pumping from the center of a circular disk embedded in a matrix of differing properties is the basis for this investigation. A solution describing flow in this configuration is obtained through Laplace-transform techniques using analytical and numerical inversion schemes. Approaches for the calculation of flow properties in conditions that can be roughly represented by this simple configuration are proposed. Possible applications include a wide variety of geologic structures, as well as the case of a well skin resulting from drilling or development. Of more importance than the specifics of these techniques for analysis of water-level responses is the insight into flow behavior during a pumping test that is provided by the large-time form of the derived solution. The solution reveals that drawdown during a pumping test can be considered to consist of two components that are dependent and independent of near-well properties, respectively. Such an interpretation of pumping-test drawdown allows some general conclusions to be drawn concerning the relationship between parameters calculated using analytical approaches based on curve-matching and those calculated using approaches based on the slope of a semilog straight line plot. The infinite-series truncation that underlies the semilog analytical approaches is shown to remove further contributions of near-well material to total drawdown. In addition, the semilog distance-drawdown approach is shown to yield an expression that is equivalent to the Thiem equation. These results allow some general recommendations to be made concerning observation-well placement for pumping tests in nonuniform aquifers. The relative diffusivity of material on either side of a discontinuity is shown to be the major factor in controlling flow behavior during the period in which the front of the cone of depression is moving across the discontinuity. The insights of this work into flow behavior during a pumping test are applicable to a wide class of nonuniform units. (Author's abstract)
W89-01196

STABLE ISOTOPE STUDY OF RECHARGE PROCESSES IN THE ENGLISH CHALK,
British Geological Survey, Wallingford (England).
W. G. Darling, and A. H. Bath.
Journal of Hydrology JHYDA7, Vol. 101, No. 1-4, p 31-46, June 30, 1988. 6 fig, 2 tab, 37 ref.

Descriptors: *Radioactivity techniques, *Tracers, *Oxygen isotopes, *Hydrogen isotopes, *Groundwater recharge, *Groundwater movement, Unsaturated zone, Infiltration, Chemistry of precipitation, Isotopes, Path of pollutants, Lysimeters, Rainfall, Aquifers.

The delta hydrogen isotope (H2) and delta oxygen isotope (O18) values of water contained in unsaturated Chalk have been measured in drillcore profiles taken over a period of 28 months on arable land in Cambridgeshire, eastern England. The isotopic composition of rainfall and lysimeter drainage on the same site has also been monitored over a period of four years. The distribution of isotope values in the upper few meters of soil and unsaturated Chalk shows that the mechanism of infiltration is not simple piston-like downward displacement since the scale of vertical fluctuations is incompatible with estimated annual infiltration and the apparent rates of movement of matrix water derived from thermonuclear tritium studies. Lysimeter drainage is not isotopically identical to matrix water at the same depth suggesting that different routes to the water table are associated with consistently different isotopic content. Although there is an apparent difference between matrix water beneath arable and permanent grassland, these differences appear to cancel out in the composition of bulk recharge beneath these land types. The regional aquifer has a uniform isotopic composition similar in value to weighted average rainfall and lysimeter drainage, suggesting that the recharge-abstraction system has been in isotopic equilibrium for many years despite changes in pumping rates and land use. Two other Chalk sites in southern England have been investigated in less detail but indicate a clear difference in infiltration behavior from that seen in Cambridgeshire; this seems to be related to a higher matrix conductivity and annual rainfall amount. (Author's abstract)
W89-01197

HYDROGEOLOGY OF TWO SASKATCHEWAN TILLS. I. FRACTURES, BULK PERMEABILITY, AND SPATIAL VARIABILITY OF DOWNWARD FLOW,

Waterloo Univ. (Ontario). Inst. for Ground Water Research.
C. K. Keller, G. Van der Kamp, and J. A. Cherry.
Journal of Hydrology JHYDA7, Vol. 101, No. 1-4, p 97-121, June 30, 1988. 12 fig, 5 tab, 29 ref.

Descriptors: *Geohydrology, *Saskatchewan, *Aquifer characteristics, *Glacial till, *Glacial aquifers, *Hydraulic permeability, *Fracture permeability, *Vertical flow, *Clays, Permeability coefficient, Geologic fractures, Groundwater movement, Flow profiles, Topography, Groundwater recharge.

Groundwater flow patterns were compared and contrasted in two deposits of clayey till of different thicknesses, both of which overlie regional aquifers in a flat upland recharge area. Analysis of 67 field and laboratory hydraulic conductivity determinations indicated that conductive fractures in the unoxidized zone of the thinner till (Dalmeny site) give rise to an isotropic bulk permeability of approximately 5 times 10 to the minus 9th power m/sec, which is two orders of magnitude greater than the bulk permeability of unoxidized till in the thicker deposit (Warman site). Vertical pore water velocities, estimated using hydraulic and isotopic evidence, vary greatly at Dalmeny and appear to be on the order of 8 m in 10,000 yr at Warman. The association of vertical groundwater flux, depth to water table, and depth of oxidized zone at a given location is referred to as the flow regime there. Spatially detailed water-level monitoring and test drilling indicated substantial variation of the flow regime at Dalmeny on a horizontal scale of tens of meters. No such variation exists at Warman. The differentiation of the flow regime at Dalmeny is due to higher till permeability, which permits a spatially-variable response to microtopographically-focused infiltration of surface water. Recognition of the causes and symptoms of flow regime variability beneath flat till landscapes has implications for environmental assessment procedures, agricultural practices, wetland management, and waste disposal. (See also W89-01202) (Author's abstract)
W89-01201

HYDROGEOLOGY OF TWO SASKATCHEWAN TILLS. II. OCCURRENCE OF SULFATE AND IMPLICATIONS FOR SOIL SALINITY,
Waterloo Univ. (Ontario). Inst. for Ground Water Research.
C. K. Keller, and G. Van der Kamp.
Journal of Hydrology JHYDA7, Vol. 101, No. 1-4, p 123-144, 12 fig, 1 tab, 19 ref. Environment Canada Water Resources Research Support Grant RA-85-10 and Natural Sciences and Engineering Research Council Grants GI372 and A8184.

Descriptors: *Glacial aquifers, *Sulfates, *Saline soils, *Glacial till, *Sulfates, *Geohydrology, *Salts, *Saskatchewan, Aquifer characteristics, Groundwater recharge, Groundwater movement, Water quality, Salinity, Flow patterns, Permeability, Soil chemistry.

The occurrence of sulfate salts in groundwater and solids was documented at two sites, named Dalmeny and Warman, where clayey tills overlie regional aquifers. At Dalmeny the till is thinner and approximately two orders of magnitude more permeable than at Warman. Samples for sulfur and sulfate determinations were collected to depths of approximately 14 m, and at horizontal spacings of a few tens of meters. Large numbers of indirect measurements of bulk salt content were obtained with a noncontacting earth conductivity meter. Results showed that the bulk sulfur and sulfate contents of solids could not in general be adequately characterized with point or grab samples from boreholes. At Dalmeny, measurements representing larger averaging volumes revealed a spatially-intricate pattern of sulfate abundance and depletion which extends vertically through the oxidized and unoxidized zones of the till to the underlying aquifer. Similar measurements at Warman suggest that sulfate variability there is limited to the oxidized zone. These findings, and the observed coincidence of sulfate patterns with the groundwater flow patterns documented elsewhere, show that the bulk permeability of the till controls the manner in which the subsurface sulfate reservoir is affected by microtopographic focusing of surface water input. Conceptual analysis of the responses of these systems to various land management practices indicates that where tills are relatively permeable, these practices would primarily affect the quality of groundwater recharge to underlying aquifers. Where tills have low permeability, the same practices would have no effect on aquifer water quality, but they would affect the potential for surface and soil salinization. (See also W89-01201) (Author's abstract)
W89-01202

IN-SITU METHOD FOR MONITORING LAYERED HYDRAULIC IMPEDANCE DEVELOPMENT DURING ARTIFICIAL RECHARGE WITH TURBID WATER,
North Dakota State Water Commission, Bismarck.
W. M. Schuh.
Journal of Hydrology JHYDA7, Vol. 101, No. 1-4, p 173-189, June 30, 1988. 9 fig, 1 tab, 20 ref.

Descriptors: *Groundwater recharge, *Artificial recharge, *Turbidity, *Pit recharge, *Suspended solids, *Impedance, Monitoring, Permeability coefficient, Infiltrometers, Tensiometers, Hydraulic gradient, Silt load, Clays.

The pit monitoring procedure requires only the measurement of the initial hydraulic conductivity, and the hydraulic conductivity during pit operation using a ring infiltrometer and a single tensiometric installation. Hydraulic gradient and impedance ratio criteria measured in a test facility enabled the extent of impedance formation due to clogging to be followed during the application of turbid water. Surface (0-8 cm) impedance changes of 200-800 times the initial impedance were measured for two sites, while only one site indicated a ten-fold to twenty-fold increase in impedance in the 8-23 cm layer. No changes in impedance were observed below 23 cm. Physical measurements indicated that deposition of silt predominated at the surface, while some of the clay penetrated to greater depths. (Author's abstract)
W89-01205

MODELING OF TRACER SPREADING IN A FRACTURE IN WHICH THE APERTURE DECREASES WITH DEPTH IN A LAMINAR FLOW (MODELISATION DE LA PROPAGATION D'UN TRACEUR DANS UNE FRACTURE QUI SE FERME PROGRESSIVEMENT EN PROFONDEUR DANS L'HYPOTHESE D'UN ECOULEMENT LAMINAIRE PARALLELE),
Lille-1 Univ., Villeneuve d'Ascq (France). Lab. de Geologie Appliquee.
E. Carlier, T. Collet, and N. Crampon.
Journal of Hydrology JHYDA7, Vol. 101, No. 1-4, p 333-358, 18 fig, 1 tab, 14 ref. English summary.

Descriptors: *Groundwater movement, *Fracture permeability, *Laminar flow, *Model studies, *Tracers, *Mathematical models, *Groundwater recharge, *Geohydrology, Hydrodynamics, Injection, Computer models, Convection.

A model is presented which studies the impulse response, the pulse response and the step function response using only the hydrodynamic convection equation. The response is a decreasing function of time in case of no partial recovery of elementary volumes of water containing a tracer, and a dissymetrical Gauss function when partial recovery occurs. The computed dispersivity does not change in case of continuous injection, and may be variable in case of impulse and short-time injection. The model also shows that a very long-tailed response curve can be obtained, suggesting a dominant influence of hydrodynamic dispersion, whereas only hydrodynamic convection is acting in an elementary volume of water. (Author's abstract)
W89-01214

NEW APPROXIMATE TECHNIQUE FOR THE HODOGRAPH METHOD IN GROUNDWATER FLOW AND ITS APPLICATION TO COASTAL AQUIFERS,
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
C. Detournay, and O. D. L. Strack.
Water Resources Research WRERAO, Vol. 24, No. 9, p 1471-1481, September 1988. 12 fig, 5 tab, 26 ref.

Descriptors: *Groundwater movement, *Mathematical analysis, *Hodograph method, *Coastal aquifers, *Approximation method, Mathematical modeling, Mathematical equations, Steady flow, Saline-freshwater interfaces, Seepage, Mapping, Plane flow, Boundaries.

The solution to a steady, two-dimensional problem of flow in a coastal aquifer is derived to illustrate the application of a new approximate analytical technique. The problem involves the determination of a phreatic surface, an interface separating flowing fresh water from salt water at rest, a seepage face, and an outflow face where fresh water leaves the homogeneously-permeable porous medium to flow into the sea. The solution which expresses the relation between the complex potential Omega and the complex variable z, defined in the flow domain, is obtained by application of conformal-mapping techniques using the hodograph method. Three auxiliary planes are introduced: the zeta plane, a reference half plane, the plane of the specific discharge function w, which is the complex conjugate of the hodograph, and the plane of the reference function R, a function of the first derivative of z and w with respect to zeta. The boundary of the flow domain, which is not known beforehand, corresponds to a polygon composed of circular arcs and straight-line segments in the w plane and to a polygon of straight lines through the origin in the R plane. The function that maps the zeta plane onto the R plane is expressed analyticaly. In the proposed technique, the analytic function zeta = zeta(w) is evaluated using a new boundary-element approximation. It is shown that the solution to the flow problem may be derived from those two relations in terms of w. (Author's abstract)
W89-01243

TIME-DEPENDENT MACRODISPERSION FOR SOLUTE TRANSPORT IN ANISOTROPIC HETEROGENEOUS AQUIFERS,
Tel-Aviv Univ. (Israel). Faculty of Engineering.
G. Dagan.
Water Resources Research WRERAO, Vol. 24, No. 9, p 1491-1500, September 1988. 4 fig, append. 28 ref.

Descriptors: *Groundwater movement, *Aquifers, *Solute transport, *Path of pollutants, *Anisotropy, Temporal distribution, Spatial distribution, Mathematical models, Isotropy, Conductivity, Analysis of variance, Estimation.

The expected values of the spatial second-order moments of a solute body transported by groundwater were derived for flow through heterogeneous formations of a stationary random anisotropic structure. They are based on a general formulation, which reduces to most existing results in the literature as particular cases. Detailed results are given for the spatial variance as a function of time in the case of axisymmetric anisotropy, average flow parallel to the plane of isotropy, first-order approximation in the log conductivity variance, and high Peclet numbers. These results fill a gap between previous studies. A preliminary investigation of the higher-order effects in log conductivity variance suggests that the use of the first-order approximations is warranted, at present, only when log conductivity variance is much smaller than 1. The uncertainty of prediction related to estimation of the parameters on which transport depends may have a large impact, depending of course on the quality of the data. (Author's abstract)
W89-01245

2G. Water In Soils

SOIL PROCESSES AND SULFATE LOSS AT THE HUBBARD BROOK EXPERIMENTAL FOREST,
Maine Univ., Orono. Dept. of Geological Sciences.
For primary bibliographic entry see Field 5B.

W89-00206

AIR AND WATER FLOW: I. HORIZONTAL FLOW WITH AN ARBITRARY FLUX BOUNDARY CONDITION,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
G. C. Sander, J.-Y. Parlange, and W. L. Hogarth.
Journal of Hydrology JHYDA7, Vol. 99, No. 3/4, p 215-223, May 30, 1988. 3 tab, 16 ref. Australian Research Grant Scheme No. F8416177I.

Descriptors: *Boundary conditions, *Mathematical models, *Air-water interfaces, *Soil water, *Flow rates, *Sorption, Wetting, Soil properties, Parlange technique, Errors, Porous media.

An approximate solution for one-dimensional horizontal, air and water flow in a porous medium subject to an arbitrary flux boundary condition was obtained by extension of Parlange's technique to include the case where air movement ahead of the wetting front is not negligible. The accuracy of this approximation was tested for a particular set of soil properties that allow an exact solution to be found for a constant surface flux. Good agreement was found at all times except near $t = 0$, where steep temporal gradients are difficult to determine accurately. This results in a maximum error of 4% at $t = 0$. However, this error diminishes very quickly as t increases and very good agreement is found for all other times. (See also W89-00348) (Author's abstract)
W89-00347

AIR AND WATER FLOW: II. GRAVITATIONAL FLOW WITH AN ARBITRARY FLUX BOUNDARY CONDITION,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
G. C. Sander, J.-Y. Parlange, and W. L. Hogarth.
Journal of Hydrology JHYDA7, Vol. 99, No. 3/4, p 225-234, May 30, 1988. 2 tab, 16 ref. Australian Research Grant Scheme F8416177I.

Descriptors: *Approximation method, *Mathematical models, *Gravity flow, *Air-water interfaces, *Boundary conditions, Soil water, Flow rates, Porous media, Erors, Temporal distribution, Infiltration.

An approximate solution is presented for one-dimensional gravitational flow of air and water in a porous medium subject to an arbitrary flux boundary condition. The accuracy of the approximate solution is determined by comparison with an exact solution for a constant flux boundary condition. The maximum error of 4% was found at small times and is due to the presence of large temporal gradients. The error is less than that obtained by most numerical procedures and analytical solutions. As time increases away from zero, these gradients decrease and good agreement is found between the exact and approximate solutions. For the case of a constant surface water content, the approximate solution reduces to a particularly simple three parameter infiltration law for air and water flow. (See also W89-00347) (Author's abstract)
W89-00348

LINEAR ROOT WATER UPTAKE MODEL,
Indian Inst. of Science, Bangalore. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2I.
W89-00353

VERTICAL VARIABILITY OF SOIL PROPERTIES IN A SMALL WATERSHED,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
L. R. Ahuja, J. W. Naney, R. D. Williams, and J. D. Ross.
Journal of Hydrology JHYDA7, Vol. 99, No. 3/4, p 307-318, May 30, 1988. 7 fig, 2 tab, 17 ref.

Descriptors: *Vertical, *Soil physical properties, *Mathematical analysis, *Variation coefficient, *Small watersheds, Spatial distribution, Correlation analysis, Hydrogen ion concentration, Phosphorus, Hydrologic models, Slopes.

Coefficient of variation, spatial trends, and correlation structure of successive depth increments were determined for several soil properties along a 200 m line transect in a sloping field. Undisturbed soil cores were taken at 21 sites in nine depth increments (15 cm) to a 135 cm depth, and used for measurements of soil bulk density, texture, water retention at several different suctions, macroporosity, organic matter content, pH, and available phosphorus (P). For each depth interval, a trend was found in all of the soil properties horizontally along the line transect, which was described adequately by a second-degree polynomial. There was also a strong vertical trend in each soil property. This vertical trend was removed from the data by subtracting the values given by the polynomial fitter to the data for each depth interval along the line transect. The detrended data were then analyzed for correlation and semivariance between 21 values for one depth and corresponding values at depths separated by one, two, three, or four lags. These sets of correlations and semivariances provided a means to test the stationarity in their values for a given lag, at different depths in the soil. The results indicated a high degree of nonstationarity in the correlation coefficients and semivariances for all properties. However, for most properties several of the correlation coefficients were significant at small lags. The mean of the correlation coefficients decreased only slowly with increase in the number of lags, and the mean semivariance showed the opposite trend. The mean semivariograms were essentially linear within the distance of four lags (60 cm). These results enhance our understanding of the vertical spatial variability structure for applications in hydrologic modeling. (Author's abstract)
W89-00354

SUBSOIL INVESTIGATION OF ICE LENSING AT THE CALGARY, CANADA, FROST HEAVE TEST FACILITY,
L.E.C. Engineering, Calgary (Alberta).
For primary bibliographic entry see Field 2C.
W89-00389

EFFECT OF ASSUMED UNIT GRADIENT DURING DRAINAGE ON THE DETERMINATION OF UNSATURATED HYDRAULIC CONDUCTIVITY AND INFILTRATION PARAMETERS,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
L. R. Ahuja, B. B. Barnes, D. K. Cassel, R. R. Bruce, and D. L. Nofziger.
Soil Science SOSCAK, Vol. 145, No. 4, p 235-243, April 1988. 8 fig, 1 tab, 24 ref.

Descriptors: *Unit gradient, *Hydraulic conductivity, *Soil water, *Permeability coefficient, *Drainage, *Infiltration, Soil properties, Soil types, Soil horizons, Tensiometers, Soil profile, Green-Ampt equation.

The unit-gradient approximation, the determination of unsaturated hydraulic conductivities using this approximation, and the parameters of the green-Ampt infiltration equation derived from those conductivities were evaluated in soils of four soil orders of the southern United States, encompassing a range of profile layering and complexity. The soils were Cecil (Typic Hapludults), Lakeland (Typic Quartzipasamments), Bethany (Pachic Argiustolls), and Konawa (Ultic Haplustalfs). The hydraulic gradients were greatly influenced by the nature and complexity of the soil profile and varied with time and depth. At some depths and times, the gradients were a factor of 2 to 5 smaller or greater than unity. A relatively large departure from the unit gradient occurred consistently in the top 30 to 40 cm of the soil. The hydraulic conductivity results showed that, from a practical point of view, appreciable discrepancies as a result of the unit-gradient approximation occurred in the upper soil horizons, at soil depths less than 20 cm for a uniform profile to depths less than 65 cm for a more complex layered profile. For these depths, the hydraulic conductivities at low suctions, calculated using the unit-gradient assumption, were always smaller than the values calculated using measured gradients. Interestingly, the Green-Ampt wetting-front suction parameter derived from the unit-gradient hydraulic conductivities was generally close to the actual value for the upper soil depths, and its value for greater depths fluctuated around the actual value. Thus, the most serious effect of the unit-gradient assumption was the underestimation of the Green-Ampt parameter of saturated or nearly saturated hydraulic conductivity in the topsoil, which occurred in both uniform and layered soils. These results suggest that tensiometers should be used to measure hydraulic gradients at least in the topsoil. (Author's abstract)
W89-00407

INTRAPEDAL MACROPORE DISTRIBUTION AND INFILTRATION RATE OF THREE FRIONA POLYPEDONS,
Texas Tech Univ., Lubbock. Dept. of Plant and Soil Science.
A. Habib, R. E. Zartman, and R. H. Ramsey.
Soil Science SOSCAK, Vol. 145, No. 4, p 244-249, 4 tab, 23 ref.

Descriptors: *Soil water, *Macropores, *Infiltration, *Irrigation, *Tillage, Polypedons, Soil types, Soil properties, Loam, Wastewater irrigation, Groundwater irrigation, Soil porosity, Comparison studies.

Intrapedal macropore size distribution and infiltration rate for three Friona fine sandy loam (Petrocalcic Paleustoll) polypedons with different tillage and hydraulic loading histories, were determined. One tilled site had been irrigated with treated wastewater, and a second had been irrigated with Ogallala aquifer water. The third site (range) had been neither tilled nor irrigated for at least 15 years. Eight pedons within each of the three polypedons were sampled to determine intrapedal macropore frequency. Fine (1- to 2-mm), medium (2- to 5-mm), coarse (5- to 10-mm), and large (> 10-mm) intrapedal macropores were categorized by size using a hand lens and reticle to measure pore diameter. Within the wastewater-irrigated treatment and the Ogallala-irrigated treatment, fewest fine intrapedal macropores were found in the top two horizons. The Btk horizons of the range treatment had the fewest fine intrapedal macropores. These horizons also had significantly lower medium and coarse macropore frequencies within their respective sites. Irrigated pedons generally had significantly greater fine intrapedal macropore frequencies than the range pedons when similar horizons were compared. In general bulk density was inversely related to fine macropore frequencies. The significantly greater infiltration rate, as measured with the flooding-basin cylinder method, of the range polypedon when compared with the tilled polypedons was most likely related to the lower bulk density of the range polypedon. Lack of correlation between intrapedal macropore frequency and infiltration rate suggested that intrapedal macropores were not responsible for a large portion of soil water movement. (Author's abstract)
W89-00408

EFFECT OF SODIUM NITRATE AND GYPSUM ON INFILTRATION AND EROSION OF A HIGHLY WEATHERED SOIL,
Georgia Univ., Athens. Dept. of Agronomy.
W. P. Miller, and J. Scifres.
Soil Science SOSCAK, Vol. 145, No. 4, p 304-309, April 1988. 2 fig, 4 tab, 23 ref.

Descriptors: *Gypsum, *Infiltration, *Erosion, *Soil erosion, *Soil physical properties, Sodium, Soil water, Runoff, Clay, Soil amendments, Sodium nitrate, Simulated rainfall, Southeastern United States.

Highly weathered soils in the southeastern United States may suffer from dispersion-related degradation of physical properties with additions of Na, either from fertilizer or wastewater sources. A clayey Southern Coastal Plain soil used in this study showed severely reduced infiltration and much higher soil loss rates, when $NaNO_3$ was

surface-applied to the soil at fertilizer rates in a rainfall simulator experiment conducted in small runoff pans. Gypsum applications, often used to reclaim naturally sodic soils, resulted in significant increases in infiltration and decreases in soil loss, when applied both alone and with NaNO3. Gypsum added to a previously Na-impacted soil improved infiltration and soil loss levels to roughly the level of untreated soil. Clay dispersion was observed in the untreated soil in the form of primary clay in the sediment; the amount of this sediment clay was greatly increased by NaNO3 treatment and was virtually eliminated by gypsum treatment, applied either alone or in combination with NaNO3. It is suggested that this dispersion accounts for the observed differences in runoff and soil loss between NaNO3, gypsum, and untreated soils. The use of gypsum may be advised on similar soils if Na is added and may be a useful amendment in the absence of applied Na as well. (Author's abstract)
W89-00409

STOKES SURFACES AND THE EFFECTS OF NEAR-SURFACE GROUNDWATER-TABLE ON AEOLIAN DEPOSITION,
McAdams, Roux and Associates, Denver, CO.
For primary bibliographic entry see Field 2J.
W89-00410

OCHRE DEPOSITS AND ASSOCIATED BACTERIA IN SOME FIELD DRAINS IN SCOTLAND,
Macaulay Inst. for Soil Research, Aberdeen (Scotland). Dept. of Microbiology.
R. E. Wheatley.
Journal of Soil Science JSSCAH, Vol. 39, No. 2, p 253-264, June 1988. 3 fig, 8 tab, 31 ref.

Descriptors: *Ochre, *Soil bacteria, *Scotland, *Drainage systems, *Soil water, Hydrogen ion concentration, Groundwater, Iron bacteria, Peat, Biological studies, Water temperature, Sulfur bacteria.

Drainage systems installed in highly organic soils, with the groundwater pH near to neutral and affected by iron ochre deposition, were studied at six sites in Scotland. The iron ochre was composed of iron-encrusted filamentous bacteria entrapping amorphous material. The filamentous bacteria were identified as Gallionella spp., Sphaerotilus natans, Leptothrix ochracea and Leptothrix pseudo-ochracea. Heterotrophic iron-oxidizing bacteria were also present in the iron ochre, but Thiobacillus ferroxidans was not isolated. Differences in the proportion of species could not be correlated with peat type or the age of the drainage system. Sulfate reducing bacteria and bacteria capable of reducing Fe(3+) were also isolated from the drainage water. A preliminary investigation of the importance of biotic factors in the kinetics of Fe(2+) oxidation showed that the rate of Fe(2+) oxidation in unfiltered drainage water, was about twice the rate in filtered water, at 10 C. Incubations over a range of temperatures showed that the differences in rates were greatest at low temperatures. (Author's abstract)
W89-00412

HYDROGEOLOGICAL AND HYDROGEOCHEMICAL STUDIES OF THE UNSATURATED FLOW IN A GRAVEL AQUIFER: PART II. RESULTS OF LONG TERM SOIL-HYDROLOGICAL MEASUREMENTS (HYDROGEOLOGISCHE UND HYDROCHEMISCHE UNTERSUCHUNGEN IN DER UNGESAETTIGTEN ZONE EINES KIESGRUNDWASSERLEITERS: TEIL II. ERGEBNISSE LANGJAEHRIGER BODENHYDROLOGISCHER MESSUNGEN),
Technische Univ., Munich (Germany, F.R.). Lehrstuhl fuer Hydrogeologie and Hydrochemie.
For primary bibliographic entry see Field 2F.
W89-00503

MULTIPLE REFLECTION AND ATTENUATION OF TIME DOMAIN REFLECTOMETRY PULSES: THEORETICAL CONSIDERATIONS OF APPLICATIONS TO SOIL AND WATER,
Department of Agriculture, Ottawa (Ontario). Land Resource Research Inst.
For primary bibliographic entry see Field 7B.
W89-00701

DETERMINATION OF ELECTRICAL CONDUCTIVITY USING TIME DOMAIN REFLECTOMETRY: SOIL AND WATER EXPERIMENTS IN COAXIAL LINES,
Department of Agriculture, Ottawa (Ontario). Land Resource Research Inst.
G. C. Topp, M. Yanuka, W. D. Zebchuk, and S. Zeelin.
Water Resources Research WRERAO, Vol. 24, No. 7, p 945-952, July 1988. 5 fig, 3 tab, 16 ref.

Descriptors: *Soil water, *Mathematical models, *Conductivity, *Geophysics, *Dielectric properties, Time domain reflectometry, Temporal distribution, Measuring instruments, Salinity.

The simultaneous measurement of water content and electrical conductivity of soils and KCl solutions was achieved using time domain reflectometry (TDR). Coaxial transmission lines varying in length from 90 to 300 mm contained either KCl solutions or soil of varied water and salt content. The water content of soil or dielectric constant of the water solutions was determined from the travel time. The measured dielectric constant of KCl solutions was unchanged from that of pure water (mean = 81) at those concentrations where there was sufficient reflected signal for measurement. Two analyses were used for determination of electrical conductivity, one based on signal attenuation after one 'round-trip' and the second based on a thin sample approximation for the signal reflection and attenuation. Reference measurements of conductivity were made on the same samples using low-frequency conductance bridge measurements. These analyses of the TDR traces showed that, for water solutions, both the thin sample analysis and the analysis after a signal had traversed one round-trip yielded conductivity in agreement with bridge conductivity values. The imaginary part of the complex dielectric constant evidently was negligible. For soils the thin sample analysis was in general agreement with the bridge measurements. From the analysis of signals after one round-trip in soils there was indication that the imaginary part of the dielectric constant should not be assumed to be negligible. Further investigation of the frequency dependence of the dielectric constant and attenuation will be required to identify the relative contributions of the real and imaginary parts of the dielectric constant to measurement by TDR. The effect of impedance-matching transformers on conductivity measurements in the field has yet to be ascertained. (See also W89-00701) (Author's abstract)
W89-00702

EXTENSION OF THE FUJITA SOLUTION TO AIR AND WATER MOVEMENT IN SOILS,
University Coll., Dublin (Ireland). Dept. of Civil Engineering.
G. C. Sander, J.-Y. Parlange, and W. L. Hogarth.
Water Resources Research WRERAO, Vol. 24, No. 7, p 1187-1191, July 1988. 3 fig, 2 tab, 16 ref.

Descriptors: *Soil properties, *Soil water, *Soil gases, *Mathematical models, *Soil absorption capacity, Soil saturation, Soil mechanics, Fujita solution, Sorptivity, Approximation method.

For specific soil properties the fundamental solution of Fujita is extended to include the effect of air movement on horizontal absorption. This exact solution is then used to determine the accuracy and range of applicability of two approximations to sorptivity with air effects previously presented by Parlange and others and Sander and Parlange. The optimal sorptivity of Parlange an others has very good accuracy while the surface water content theta(s) is near saturation but decreases in accuracy as theta(s) decreases. The approximate sorptivity of Sander and Parlange, however, proves to be extremely accurate for all theta(s) with a maximum error of only 0.5%. Sander and Parlange additionally give an approximation to the water profile which is also shown by comparison with the exact solution to have a maximum error of only 0.5%. The aim in this study is primarily of a theoretical nature in that the exact solution is used to check the accuracy of the approximate solutions as stated above. Alternatively, the solution may be used for checking the accuracy of numerical models. (Author's abstract)
W89-00725

STEADY UNSATURATED SEEPAGE ABOVE A SLOPING IMPERMEABLE BASE,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
J. R. Philip.
Water Resources Research WRERAO, Vol. 24, No. 7, p 1192-1196, July 1988. 1 fig, 16 ref.

Descriptors: *Infiltration, *Dimensional analysis, *Seepage, *Mathematical models, *Unsaturated flow, Sloping impermeable base, Asymptotic analysis, Kirchoff potential.

The nonexistence of steady unsaturated flows in regions infinite in the horizontal and bounded below by a horizontal impermeable base is established. Asymptotic analyses are given of two- and three-dimensional seepage above a sloping impermeable base, valid far from the water supply source(s). The solutions depend only on total source discharge: details of source configuration are irrelevant. It is required only that the discharge be positive and finite and that the sources be contained in a finite region. Two-dimensional results are found both for quasi-linear and for general nonlinear flows. The general results apply also to mixed saturated-unsaturated flows. The asymptotic 3-dimensional quasi-linear results involve the same functional forms as analogous 2-dimensional flows in unbounded regions. An upper bound on unsaturated total discharge exists for 2-dimensional systems. Use of the potential Omega, a line integral of the Kirchoff potential, effectively reduces by one the dimensionality of the problems treated. In one instance the dimensionality is reduced by two after a second integration. (Author's abstract)
W89-00726

INFILTRATION UNDER PONDED CONDITIONS: 2. INFILTRATION EQUATIONS TESTED FOR PARAMETER TIME-DEPENDENCE AND PREDICTIVE USE,
Universite Scientifique et Medicale de Grenoble (France). Inst. de Mecanique.
R. Haverkamp, M. Kutilek, J. Y. Parlange, L. Rendon, and M. Krejca.
Soil Science SOSCAK, Vol. 145, No. 5, p 317-329, May 1988. 1 fig, 8 tab, 23 ref.

Descriptors: *Soil water, *Infiltration, *Ponding, *Mathematical equations, Comparison studies, Prediction, Precision, Mathematical analysis, Numerical analysis, Mathematical models, Parlange infiltration equation.

Six different infiltration equations were analyzed for precision, parameter time-dependence, and applicability for predictive use. The tests were carried out by comparison with reference solutions, i.e., analytical, experimental, or numerical, for two different head conditions at the soil surface. The results showed that all the infiltration equations but those of Kostiakov and Horton, satisfy sufficiently well the imposed precision criterion. Only one model, however, the Parlange infiltration equation, had the advantage of using parameters that were constant in time and independent of the number of data points chosen for their evaluation procedure. The parameters entering into the other algebraic infiltration equations had to be considered as fitting parameters without physical significance and representative only of the experiment for which they were determined. (Author's abstract)
W89-00740

HORIZONTAL INFILTRATION OF WATER IN SOIL COLUMNS AS AFFECTED BY A GEL-FORMING CONDITIONER,
King Saud Univ., Riyadh (Saudi Arabia). Dept. of

Soil Science.
M. A. Mustafa, A. M. Al-Omran, A. S. Shalaby, and A. M. Al-Darby.
Soil Science SOSCAK, Vol. 145, No. 5, p 330-336, May 1988. 7 fig, 4 tab, 11 ref.

Descriptors: *Soil water, *Soil sealants, *Infiltration, Gels, Soil porosity, Soil texture, Deep percolation, Humic acids, Soil columns, Permeability, Diffusivity, Pore size, Soil types, Soil moisture retention.

Proper modification of the pore-size distribution is a key for improving the productivity of coarse-textured soils that are limited by their low water-holding capacity and excessive deep percolation. A laboratory experiment was conducted on the interrelationships among five rates, 0 to 1.6%, of a gel-forming conditioner (Jalma--containing 24.5% humic acids and 3.8% polysaccharides), water penetrability, weighted-mean diffusivity, swelling index, and effective mean pore radius of a loamy sand, a sandy loam, and a loam. For each of the three soils, the results indicated a highly significant linear increase in swelling index and a consequent exponential decrease in pore radius, water penetrability, and weighted-mean diffusivity with increase of rate. The effects of Jalma on these parameters were more marked on the loamy sand than on the other two soil samples. Addition of 0.2, 0.4, 0.8, and 1.6% Jalma to the loamy sand sample significantly reduced water penetrability by about 19, 55, 83, and 98%, respectively, and weighted-mean diffusivity by about 38, 76, 96, and 100%. The highest rate almost completely sealed the soil independent of its texture and reduced weighted-mean diffusivity to almost zero. It was concluded that 0.4% Jalma is the optimum rate for soil-water conservation. It is argued that Jalma causes swelling of the soil matrix, reduces the effective mean pore radius, and consequently reduces water penetrability and weighted-mean diffusivity. The effective mean pore radius proved to be a reliable predictor of weighted-mean diffusivity and water penetrability of the soil samples studied independent of their texture. (Author's abstract)
W89-00741

SUBSURFACE DRAINAGE PEAK FLOWS IN SHALLOW SOIL,
Centre National du Machinisme Agricole, du Genie Rural, des Eaux et des Forets, Antony (France). Div. Drainage et Assainissement Agricoles.
For primary bibliographic entry see Field 4A.
W89-00749

WATER FLOW IN LAYERED SOILS WITH SLOPING SURFACE,
Louisiana State Univ., Baton Rouge.
H. M. Selim.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 114, No. 3, p 442-462, August 1988. 11 fig, 3 tab, 13 ref, append.

Descriptors: *Storm seepage, *Soil horizons, *Slopes, *Soil water, *Porous media, *Hydraulic conductivity, Capillary water, Saturated soils, Saturated flow, Vertical flow, Flow rates, Model studies, Flow patterns, Anisotropy, Shallow water, Soil horizons, Percolation.

An analytical solution is derived for a two-dimensional soil with a sloping surface under steady and water-saturated flow conditions. The soil was assumed to consist of several layers, each horizontally stratified. The lower layer was assumed to extend to a great depth. Each layer was considered anisotropic in nature where the hydraulic conductivity in the vertical (kappa) and the horizontal (epsilon) directions are dissimilar. Potential and stream functions are obtained and several flow nets are presented for two-layered soils with varying degrees of anisotropy. The range of values chosen was epsilon = (1/25)kappa to epsilon = 16(kappa) and equivalent hydraulic conductivities for two soil layers (K sub 1/K sub 2) were 1:1, 1:10, and 10:1. The results illustrate the significance of the degree of anisotropy of each soil layer on the water flow pattern, the relative flow rate, and the volume of water passing through individual soil layers. The presence of an anisotropic lower layer did not influence the relative flow rate, and the volume of water passing through individual soil layers. The presence of an anisotropic lower layer did not influence the relative flow rate entering (or leaving) the soil. Moreover, for most cases, the location along the soil surface that separates seepage into and out of the soil was not influenced by the degree of anisotropy of the infinitely thick lower layer. (Author's abstract)
W89-00752

EXPLICIT SOLUTION TO GREEN-AMPT EQUATION FOR NONUNIFORM SOILS,
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
For primary bibliographic entry see Field 7B.
W89-00760

PRODUCTIVITY AND NUTRIENT CYCLING OF ALASKAN TUNDRA: ENHANCEMENT BY FLOWING SOIL WATER,
Alaska Univ., Fairbanks. Inst. of Arctic Biology.
F. S. Chapin, N. Fetcher, K. Kielland, K. R. Everett, and A. E. Linkins.
Ecology ECOLAR, Vol. 69, No. 3, p 693-702, June 1988. 2 fig, 7 tab, 53 ref.

Descriptors: *Productivity, *Cycling nutrients, *Tundra, *Alaska, *Soil water, Biomass, Nitrogen, Eriophorum, Phosphatase, Subsurface water, Phosphorus, Soil temperature, Flow rates, Ammonium, Phosphates.

Patterns of biomass, productivity, and nutrient cycling were compared between water track and nontrack areas in Alaskan tussock tundra. Water tracks sampled in Alaskan tundra were 2.4 times more productive than adjacent nontrack areas due almost entirely to the 10 times greater above-ground production of the sedge Eriophorum vaginatum L. in the track. Nitrogen and phosphorus cycled more rapidly in water tracks than in non-track areas due to slightly warmer soil temperature, deeper thaw, higher soil phosphatase and protease activities, and more rapid nitrogen mineralization. Roots of E. vaginatum growing in the track had a high capacity to absorb ammonium and phosphate and thus could exploit nutrients brought to the root surface by flowing soil water. The low degree of mycorrhizal colonization of these roots makes E. vaginatum particularly sensitive to the rate of nutrient movement to the root surface. The enhanced productivity and nutrient cycling in the water track compared with adjacent tundra probably reflect increased nutrient flux to the root surface caused by flowing water in the water track. (Author's abstract)
W89-00908

FINITE ELEMENT COMPUTATION OF SHAPE FACTORS FOR KIRKHAM'S PIEZOMETER TUBE METHOD FOR HYDRAULIC CONDUCTIVITY OF SATURATED SOIL,
Dundee Univ. (Scotland). Dept. of Mechanical Engineering.
J. M. B. Brown, and M. P. Hodgson.
Hydrological Processes HYPRE3, Vol. 2, No. 3, p 219-225, July-September 1988. 5 fig, 3 tab, 12 ref.

Descriptors: *Finite element method, *Piezometers, *Hydraulic conductivity, *Saturated soils, Mathematical analysis.

The Kirkham piezometer tube method of measuring hydraulic conductivity of saturated soil uses a numerical constant (shape factor) to account for the relative geometrical parameters of the cavity and the soil domain. Published shape factors have mostly been determined using an electrical analogue. The application of the finite element method to shape factor determination is considered. Convergence was studied and methods of extrapolation evaluated. A determination was made of the size of finite region required to represent adequately the radially unbounded domain assumed for the piezometer method. Computed shape factors were found to be in good agreement with analogue data. (Author's abstract)
W89-00911

COMPARISON OF TWO METHODS FOR SUMMARIZING HYDRAULIC CONDUCTIVITIES OF A LAYERED SOIL,
Kansas State Univ., Manhattan. Dept. of Agronomy.
J. B. Sisson, W. M. Klittich, and S. B. Salem.
Water Resources Research WRERAO, Vol. 24, No. 8, p 1271-1276, August 1988. 6 fig, 4 tab, 13 ref.

Descriptors: *Groundwater movement, *Mathematical models, *Hydraulic conductivity, *Soill profiles, *Mathematical studies, *Soil water, Groundwater hydrology, Hydraulic properties, Model studies, Parametric hydrology, Comparison studies.

Hydraulic conductivity data are frequently summarized using mathematical functions that quantify the relationship between water content (theta) and hydraulic conductivity (K(theta)). This study was done to determine the effects of the choice of the K(theta) function and to determine if field data from layered profiles could be summarized using only one parameter per depth. Three K(theta) functions together with a matching factor were fitted to hydraulic conductivity data from a field plot. The functions were K sub m (theta/theta sub m) to the 1/beta power, K sub m (theta minus theta sub c)/(theta sub m minus theta sub c)) to the 1/n power, and K sub m exp (alpha (theta minus theta sub m)), where alpha, beta, n, K sub m, theta sub c and theta sub m are parameters to be estimated. For each function, two methods were considered. Method 1 fitted a different value to alpha, beta, n, and K sub m for each depth while maintaining theta sub c at a fixed value. All hydraulic conductivity functions fit data from a Muir silt loam equally well, as evidenced by the coefficient of linearity (r squared) values greater than 0.72, mean square error (MSE) values less than 0.97, and coefficient of variation (CV) values less than 50%. The fitting was accomplished using ln (K) as the dependent variable. Method 2 fitted values by depth only to K sub m, and all other parameters were held constant. The hydraulic conductivity functions performed equally well, with r squared values greater than 0.60, MSE values less than 1.2, and CV values of 50% or less. When some loss of precision can be tolerated, the number of parameters required to summarize data from a layered soil can be reduced. (Author's abstract)
W89-00970

IMPROVED METHODOLOGY FOR A COLLINEAR DUAL-ENERGY GAMMA RADIATION SYSTEM,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
For primary bibliographic entry see Field 7B.
W89-00985

SIMULATION MODEL FOR BIOTRANSFORMATION OF XENOBIOTICS AND CHEMOTAXIS IN SOIL COLUMNS,
Agricultural Univ., Wageningen (Netherlands). Dept. of Microbiology.
For primary bibliographic entry see Field 5B.
W89-00989

MODELLING SOIL WATER DYNAMICS IN THE UNSATURATED ZONE: STATE OF THE ART,
Institute for Land and Water Management Research, Wageningen (Netherlands).
R. A. Feddes, P. Kabat, P. J. T. Van Bakel, J. J. B. Bronswijk, and J. Halbertsma.
Journal of Hydrology JHYDA7, Vol. 100, No. 1/3, p 69-111, July 30, 1988. 13 fig, 146 ref.

Descriptors: *Model studies, *Soil water, *Literature reviews, *Unsaturated flow, *Aeration zone, Frozen soil, Water management, Roots, Evapotranspiration, Infiltration, Earth dams, Seepage, Crop yield, Water use, Water supply, Remote sensing.

The principles underlying water dynamics in the unsaturated zone are reviewed and is presented an

overview of simulation modeling of soil water flow in the unsaturated zone. The basic relations describing kinetics of flow and governing equations of flow in the unsaturated zone are presented in a general form considering unsteady multidimensional anisotropic and nonhomogeneous flow in the presence of sinks/sources. The influence of overburden potential, characterizing swelling soils, on water transport through the unsaturated zone is discussed. Outlines of thermally-induced water flow are presented with an extension to the specific case of frozen soils. Complex relationships describing the hydrological system are reduced into the one-dimensional vertical flow cases, for which the mathematical models are defined. The entire model has the form of a set of partial differential equations together with auxiliary conditions, that describe the system's geometry, parameters, boundary conditions, and initial conditions. Numerical approximations to solve governing equations of unsaturated water flow are emphasized. The advantages and disadvantages of recently-introduced numerical models are given. Atmospheric boundary conditions of the modeled system are described with a maximizing procedure of the flux through the soil-air interface. Several options to define lower boundary conditions are discussed, and a special type of lower boundary condition is given for the case that unsaturated flow is coupled with a regional groundwater model. The current status of collecting model parameters is discussed as well as measurement of common verification data. Efforts to simulate preferential flow of water through unsaturated flow are evaluated. Attempts to build hysteresis into dynamic simulation models are rare. Practical examples of simulation of flow problems are given. These include seepage through an earth dam, field water use and potato crop yield, a water supply plan for agriculture in northeastern Netherlands, and integration of remote sensing with a water balance simulation model. (Cassar-PTT)
W89-01014

TRACING OF WATER MOVEMENT IN THE UNSATURATED ZONE USING STABLE ISOTOPES OF HYDROGEN AND OXYGEN,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Water Resources.
C. J. Barnes, and G. B. Allison.
Journal of Hydrology JHYDA7, Vol. 100, No. 1/3, p 143-176, July 30, 1988. 12 fig, 85 ref.

Descriptors: *Soil water, *Literature reviews, *Aeration zone, *Tracers, *Isotope studies, Evaporation, Oxygen isotopes, Hydrogen isotopes, Radioisotopes, Saline soils, Brines, Vegetation, Groundwater recharge, Recharge, Infiltration, Arid zones.

A model of isotope movement in soils was developed to account for unsaturated, nonisothermal and unsteady flow in both liquid and gas phase (evaporation). Although experimental evidence for the validity of each part of the model in isolation has been obtained, verification of the combined model has been difficult. An advantage of the stable isotope technique in determination of water movement is the limited variability of the effective diffusivities with varying water content, compared to the marked variation of the soil water diffusivity. However, it fails to achieve the precision potentially available in estimating evaporation rates and determining soil physical mechanisms operating during evaporation. Although temperature effects on soil water profiles and fluxes can be significant, they appear to have little effect on isotope profiles. Care must be taken in estimating evaporation rates of saline solutions, especially those near saturation. Isotope profiles beneath grass were relatively less enriched than nearby profiles under bare ground. The roles of root fractionation, reduction in soil evaporation, selective infiltration, and transpiration were studied. Isotope profiles were applied to studies of groundwater recharge rates and mechanisms, estimation of evaporation rate in very dry soils, time for profile development and effect of infiltration, and examination of arid zone profiles. (Cassar-PTT)
W89-01016

SOIL PHYSICS AND HYDROLOGY,
E. G. Youngs.
Journal of Hydrology JHYDA7, Vol. 100, No. 1/3, p 411-431, July 30, 1988. 4 fig, 64 ref.

Descriptors: *Unsaturated flow, *Hydrology, *Soil physics, *Soil water, *Literature reviews, Pore water, Groundwater movement, Flow, Infiltration, Model studies, Mathematical models, Richards equation, Green-Ampt model, Hydraulic conductivity, Seepage, Soil properties, Hydrologic models, Physical properties, Soil physical properties, Drainage.

Soil physics provides the physical basis for calculating soil-water flow in hydrological models, particularly that through the region of unsaturated soil that acts as a buffer between the atmosphere and the groundwater zone. The development of the continuum theory of soil-water movement is outlined and its success in describing soil-water behavior in infiltration and drainage processes discussed. In particular, assumptions in the theory are examined, together with the use of the simplifying Green and Ampt approximate analysis. For multidimensional infiltration steady-state flows obtained assuming a step-function relationship between hydraulic conductivity and soil-water pressure, as implied in the Green and Ampt analysis, and those obtained assuming an exponential relationship, are both found to agree satisfactorily with experiment. Scaling of soil-water behavior based on similar media theory and also seepage analysis of groundwater flow are introduced. Complicating physical factors, such as soil heterogeneity, swelling and shrinking, and aggregation that occur in field situations and often make classical theory too simplistic, are considered. (Author's abstract)
W89-01026

TRANSPORT OF SOLUTES IN SOILS AND AQUIFERS,
Agricultural Univ., Wageningen (Netherlands). Dept. of Land and Water Use.
For primary bibliographic entry see Field 5B.
W89-01027

SORPTION AND DEGRADATION OF ALDICARB AND ITS OXIDATION PRODUCTS IN A SOIL-WATER FLOW SYSTEM AS A FUNCTION OF PH AND TEMPERATURE,
Cornell Univ., Ithaca, NY.
For primary bibliographic entry see Field 5B.
W89-01164

EFFECTS OF LEACHING AND WHOLE-TREE HARVESTING ON CATION BUDGETS OF SEVERAL FORESTS,
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 4C.
W89-01166

POSSIBLE MECHANISM FOR MANGANESE PHYTOTOXICITY IN HAWAII SOILS AMENDED WITH A LOW-MANGANESE SEWAGE SLUDGE,
Hawaii Univ. at Manoa, Honolulu. Dept. of Agronomy and Soil Science.
For primary bibliographic entry see Field 5E.
W89-01169

STABILITY OF SAND SLOPES IN THE GROUNDWATER DISCHARGE ZONES,
For primary bibliographic entry see Field 8D.
W89-01174

ROLE OF SOIL ORGANIC MATTER IN THE GEOCHEMICAL CYCLING OF CHLORIDE AND BROMIDE,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Water Resources.
For primary bibliographic entry see Field 2A.
W89-01200

SENSITIVITY ANALYSIS OF CLOSED-FORM ANALYTICAL HYDRAULIC CONDUCTIVITY MODELS,
Thessaloniki Univ., Salonika (Greece). Faculty of Engineering.
E. Sidiropoulos, and S. Yannopoulos.
Journal of Hydrology JHYDA7, Vol. 101, No. 1-4, p 159-172, June 30, 1988. 11 fig, 11 ref.

Descriptors: *Hydraulic conductivity, *Soil water, *Sensitivity analysis, Mathematical models, Algorithms.

The three fitting parameters in the Van Genuchten analytical soil-moisture characteristic curve are considered to be independent in this paper. The three-parameter fitting problem that arises is reduced to a one-dimensional minimization search, through a suitable transformation. The resulting unidimensional algorithm is amenable to analysis. Its qualitative characteristics are derived and the existence of a minimum is established. The values of the parameters thus obtained are introduced as starting estimates in a three-parameter minimization process of the Newton-Raphson type. As a continuation of this, a sensitivity analysis is formulated of the unsaturated hydraulic conductivity with respect to the residual and the saturated water content. The entire analysis is applied to the retention data of five selected soils of different hydraulic properties. In all cases considered, the very good fit offered by the unidimensional algorithm is demonstrated. Also, the sensitivity of the hydraulic conductivity shows a drastic increase in the range of lower water contents, and the sensitivity with respect to the saturated water content maintains nonnegligible values over the whole water content range. (Author's abstract)
W89-01204

ESTIMATING SOIL/SEDIMENT PARTITION COEFFICIENTS FOR ORGANIC COMPOUNDS BY HIGH PERFORMANCE REVERSE PHASE LIQUID CHROMATOGRAPHY,
Michigan Univ., Ann Arbor. Dept. of Environmental and Water Resources Engineering.
For primary bibliographic entry see Field 5B.
W89-01223

FATE AND TRANSPORT OF ORGANICS IN SOIL: MODEL PREDICTIONS AND EXPERIMENTAL RESULTS,
Utah State Univ., Logan. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-01239

IMPACT OF RAINFALL AND SOIL HYDRAULIC PROPERTY INFORMATION ON RUNOFF PREDICTIONS AT THE HILLSLOPE SCALE,
Hawaii Univ. at Manoa, Honolulu. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 2E.
W89-01246

2H. Lakes

PHYTOPLANKTON COMPOSITION OF STAGNANT AND TIDAL ECOSYSTEMS IN RELATION TO SALINITY, NUTRIENTS, LIGHT AND TURBULENCE,
Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
For primary bibliographic entry see Field 2L.
W89-00001

DISTRIBUTION, DYNAMICS AND PRODUCTIVITY OF A COLONIZING (POLYDORA QUADRILOBATA) AND AN ESTABLISHED (P. LIGNI) POLYDORID POLYCHAETE IN LAKE GREVELINGEN: AN ENCLOSED ESTUARY IN THE SW NETHERLANDS,
Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
R. H. D. Lambeck, and P. Valentijn.
Netherlands Journal of Sea Research NJSRBA,

Vol. 21, No. 2, p 143-158, June 1987. 10 fig, 4 tab, 61 ref.

Descriptors: *Limnology, *Aquatic habitats, *Lake Grevelingen, *Lakes, *Saline lakes, *Estuaries, *Macroinvertebrates, *Polychaetes, Population dynamics, Species distribution, Biomass, Productivity, Seasonal variation, Life cycles, Netherlands, Time series analysis, Dam effects.

The enclosure by a dam of the Grevelingen estuary in May 1971 (from then on saline Lake Grevelingen) did not result in an immediate population response of Polydora ligni, known as an opportunist. A large summer settlement (2 to 5000 individuals (ind)/sq m) and a subsequent high mortality occurred at one station in the period 1972-75; abundance fluctuations at a second station were much smaller. In 1977 densities were very low. The congeneric P. quadrilobata (a species new to Dutch waters) was not observed in 1971-75, but an average density of 760 ind/sq m (with a biomass of 0.1 g as-free dry weight (ADW)/sq m) was found in the lake in April 1977. Its abundance was low in shallow water (<2.5 m); in the rest (54%) of the lake no preference for depth, substrate or species association could be detected. Seasonal maxima occurred in spring. These opposing population developments can be explained from the different life histories of the two polydorids in combination with a changed seasonal pattern in food supply. The maximum life span of P. quadrilobata was 1 to 1 1/2 years with one main cohort a year. Maximum values for its biomass and density at the stations were 1.42 g ADW/sq m and 6900 ind/sq m. Based on reconstructed survivorship curves, annual minimum and maximum values for production were calculated. The (conservative) estimates varied from 0.2 to 2.6 g ADW/sq m/a for different stations and years, with P/B values varying from 1.5 to 8.2. (Author's abstract)
W89-00002

SEASONAL AND SHORT-TERM FLUCTUATIONS IN THE ZOOPLANKTON COMMUNITY OF PARANOA RESERVOIR, BRASILIA, FEDERAL DISTRICT, BRAZIL (FLUTUACOES SAZONAIS E DE CURTA DURACAO NA COMUNIDADE ZOOPLANKTONICA DO LAGO PARANOA, BRASILIA-DF, BRASIL),

Universidade Federal de Minas Gerais, Belo Horizonte (Brazil). Inst. de Ciencias Biologicas.
R. M. Pinto-Coelho.
Revista Brasileira de Biologia RBBIAL, Vol. 47, No. 1/2, p 17-29, February/May 1987. 8 fig, 2 tab, 48 ref. English summary.

Descriptors: *Paranoa Reservoir, *Brazil, *Limnology, *Zooplankton, *Reservoirs, *Species composition, *Seasonal variation, Rotifers, Aquatic insects, Crustaceans, Tropical regions, Variation coefficient.

The composition and seasonal variation of the zooplankton in Paranoa Reservoir were studied from August 1982 through July 1983. Short-term variations of the zooplankton community were observed during two intensive sampling programs in the dry season (August-September 1982) and the rainy season (November-December 1982). Zooplankton populations decreased during the rainy season. Intensive sampling revealed that the short-term coefficients of variation of the populations of some plankters, especially rotifers and cladocerans, were similar or even greater than the long-term annual coefficients of variation. (Author's abstract)
W89-00006

DECOMPOSITION RATES OF ALLOCHTHONOUS MATERIAL (LITTER) IN LAKE CARIOCA - RIO DOCE FOREST PARK - MG (TAXA DE DECOMPOSICAO DO MATERIAL ALOCTONE 'LITTER' NA LAGOA CARIOCA - PARQUE FLORESTAL DO RIO DOCE - MINAS GERIAS),

Universidade Federal de Minas Gerais, Belo Horizonte (Brazil). Inst. de Ciencias Biologicas.
F. A. R. Barbosa, and M. E. Coutinho.
Revista Brasileira de Biologia RBBIAL, Vol. 47, No. 1/2, p 37-45, February/May 1987. 2 fig. 3 tab, 37 ref. English summary.

Descriptors: *Limnology, *Lakes, *Litter, *Decomposing organic matter, *Lake Carioca, *Brazil, Organic matter, Nitrogen, Phosphorus, Organic carbon, Proteins, Polyphenols, Organic compounds, Plant tissues, Phytoplankton, Tropical regions, Biomass.

An evaluation of the decomposition rates of the main litter fractions (leaves and stems) and the annual litter contribution was made through the determination of the biomass decrease (% dry weight) and the variation of the levels of organic matter, total nitrogen and phosphorus, organic carbon, crude proteins, and polyphenols. Such estimate were made after periods of 3, 5, 30, 60, and 90 days of incubation in the littoral zone of Lake Carioca, Eastern Brazil. The annual litter production was 6.8 ton/sq m of which 79.2 was due to leaves, 17.8 to stems and 3% to fruits and seeds. The levels of organic matter changed very little, with only 8% loss of the leaf fraction and 1% of the stem fraction. Total nitrogen and phosphorus showed great variation during these periods. Polyphenols showed very distinct patterns of decomposition between the two fractions. The litter decomposition rate was seen as a source for the organic matter and a comparison with autochthonous organic matter production by phytoplankton was also made. Possible causes for the variation of chemical composition as a function of time are suggested. (Author's abstract)
W89-00007

FRESHWATER MOLLUSKS AS INDICATORS OF TROPHIC CONDITIONS IN COASTAL LAKES OF SOUTHERN BRAZIL (MOLUSCOS DULCEAQUICOLAS COMO INDICADORES DE CONDICOES TROFICAS EM LAGOAS COSTEIRAS DO SUL DO BRASIL),

Universitaet des Saarlandes, Saarbruecken (Germany, F.R.). Inst. fuer Biogeographie.
For primary bibliographic entry see Field 5A.
W89-00008

NUTRIENT RELEASE THROUGH DECOMPOSITION OF DIPLODON DELODONTUS EXPANSUS (MOLLUSCA, BIVALVIA) AND SOME CONSIDERATIONS OF ITS EFFECTS ON THE ECOLOGY OF A SMALL TROPICAL RESERVOIR,

Universidade Estadual Paulista, Botucatu (Brazil). Dept. of Zoology.
R. Henry, and S. Filoso.
Revista Brasileira de Biologia RBBIAL, Vol. 47, No. 4, p 479-486, November 1987. 7 fig, 1 tab, 14 ref. English summary.

Descriptors: *Brazil, *Limnology, *Reservoirs, *Nutrients, *Decomposing organic matter, *Rio Pardo Reservoir, Decomposition, Mollusks, Phytoplankton, Tropical regions, Ecology, Biomass, Conductivity, Ammonia, Phosphate, Calcium, Cycling nutrients, Primary productivity.

The biomass loss by decomposition of Diplodon delodontus expansus of two groups of organisms (G1: shells only and G2:shells with body), was measured during 2 months in the Rio Pardo Reservoir and in 500 l containers. The effects of mollusk decomposition on water chemistry were evaluated through the weekly measurements of conductivity, ammonia, total and inorganic phosphate, and calcium. The potential growth of phytoplankton from the Rio Pardo Reservoir was measured through an enrichment experiment using as nutritive media the nutrients resulting from decomposition of the bivalves. The results showed that the biomass loss was higher in the reservoir when compared with the organisms incubated in the containers. The release of ammonia and calcium by dry weight was higher in water containing bivalves from group G2 compared to group G1 organisms. Significant growth of phytoplankton was observed after 12 days in the enriched water with a nutritive solution resulting from decomposition of G2 organisms. The increase of phytoplankton biomass in enriched water with a nutritive solution of G1 organisms did not differ from control. The ecological significance of bivalve decomposition on the ecology of the Rio Pardo Reservoir is discussed. (Author's abstract)
W89-00009

FISH COMMUNITIES IN RESERVOIRS IN SOUTHERN BRAZIL (COMUNIDADES DE PEIXES DE RESERVATORIOS NO SUL DO BRASIL),

Sao Paulo Univ., Ribeirao Preto (Brazil). Faculdade de Filosofia, Ciencias e Letras.
R. M. Correae Castro, and M. S. Arcifa.
Revista Brasileira de Biologia RBBIAL, Vol. 47, No. 4, p 493-500, November 1987. 1 fig, 4 tab, 21 ref. English summary.

Descriptors: *Reservoirs, *Fish populations, Species composition, Population density, Species diversity, Brazil, Dam effects.

A survey was carried out on the fish communities in 9 reservoirs located in Sao Paulo State. Through the employment of nets, mainly gill nets, the species and their relative abundance were ascertained, on two occasions in 1979. Twenty-five genera and 39 species were sampled, belonging mostly to the Ostariophysi. The most abundant species were Curimata modesta, Astyanax fasciatus, A. bimaculatus, Astyanax sp., and Geophagus brasiliensis. Through the use of the Jaccard similarity index, 3 groups of reservoirs were obtained, according to the basins of the impounded rivers: Paraiba do Sul, Atibaia, and Tiete. The fish diversity of the reservoirs is related to that of their impounded rivers, being smaller in those originating from headwater streams. (Author's abstract)
W89-00011

HYPOLIMNETIC CHLOROPHYLL MAXIMUM BY ALGAE AND SULPHUR BACTERIA IN ONE EUTROPHIC POND,

Jyvaeskylae Univ. (Finland). Dept. of Biology.
P. Eloranta.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 71, No. 3, p 459-469, September 1985. 4 fig, 2 tab, 21 ref.

Descriptors: *Ponds, *Limnology, *Phytoplankton, *Algae, *Sulfur bacteria, *Photosynthetic bacteria, *Photosynthesis, *Chlorophyll, Hypolimnion, Pigments, Carotenoids, Spectroscopy, Chromatography, Aquatic bacteria.

High hypolimnetic chlorophyll concentrations are usually caused by photosynthetic sulfur bacteria. The normal integrated phytoplankton samples may consist of a mixture of algal and bacterial populations. Although the water layer with bacteria can be thin, the bacterial pigments may cause misleading results in the chlorophyll analyses made by conventional spectrophotometric methods. The sulfur bacteria have characteristic chlorophylls and have only a few carotenoids, which cause typical shifts in the absorption spectra. Thus the possible occurrence of the sulfur bacteria in pigment samples can be detected by the form of the absorption spectrum of the total pigment extract or by chromatographic methods. (Author's abstract)
W89-00012

SCIENTIFIC CONCEPTS AND METHODOLOGIES PERTINENT TO LAKE RESEARCH AND LAKE RESTORATION,

National Water Research Inst., Burlington (Ontario).
R. A. Vollenweider.
Schweizerische Zeitschrift fuer Hydrologie SZHYA6, Vol. 49, No. 2, p 129-147, August 1987. 8 fig, 7 tab, 33 ref.

Descriptors: *Limnology, *Lake restoration, *Water management, *Water pollution treatments, Remedies, Mathematical models, Research priorities.

The scientific concepts and principles pertinent to lake restoration do not differ essentially from those of classical limnological research in general. The more specific question of their applicability to practical lake management is not so much one of further addition to, but one of appropriate selection from the list already available. This study

provides a perspective on how, and in what way, current scientific principles and concepts can be visualized within a synthetic framework pertinent to lake research and lake restoration. Topics considered are as follows: strategic principals pertinent to lake water management, an overview of water pollution problems, hierarchical and contingency concepts in limnological and water management research, remedial measures and pollution control measures, mathematical models for lake management, and information gains from limnological research in relation to single-case vs. cross-sectional studies. (Sand-PTT)
W89-00013

BACKGROUND ASPECTS OF LAKE RESTORATION: WATER BALANCE, HEAVY METAL CONTENT, PHOSPHORUS HOMEOSTASIS,
Northwestern Univ., Evanston, IL. Dept. of Geological Sciences.
A. Lerman, and A. B. Hull.
Schweizerische Zeitschrift fuer Hydrologie SZHYA6, Vol. 49, No. 2, p 148-169, August 1987. 7 fig, 3 tab, 49 ref, append. NATO Scientific Affairs Division, Grant 050(81).

Descriptors: *Limnology, *Lake restoration, *Hydrologic budget, *Heavy metals, *Phosphorus fertilization, Volcanic lakes, Glacial lakes, Rift valley lakes, Deep valley lakes, Saline lakes, Water depth, Lake sediments, Drinking water, Haneostasis, Water pollution sources, Comparison studies, Morphometry, Remedies.

Perturbations of the lake water balance, inputs of heavy metals to lakes, and intensifying fertilization of lakes through input and accumulation of phosphorus are 3 classes of phenomena among the more important background processes in lake restoration. The success of the implementation of lake restoration is affected by the morphometric and edaphic parameters of different types of lakes. The relationship between the volume (V) and mean depth (z) of fresh-water lakes indicates a trend of V proportional to z cubed. Glacial lakes occurring on or near crystalline shields have relatively shallow depths, whereas volcanic lakes, rift valley and deep valley lakes have relatively greater depths for the same volume. For saline lakes that undergo cycles of expansion and shrinkage, the V to z relationship is closer to power 1. Water residence times (tau) of small and big freshwater lakes show a trend of tau approximately linear in z or tau proportional to V to the 0.3 power. Volcanic lakes and Maare have longer residence times in comparison to other lakes of similar volumes. For the major inorganic chemical species and heavy metals, the regulatory upper limit concentrations in drinking water in the USA and European Economic Community are from several times to more than 100 times higher than their concentrations in a global mean river water. Only 3 elements (Fe, P and Al) occur in river water at concentrations approaching such upper limit recommendations. Rates of accumulation of P in lake water and sediments, computed as the difference between input and outflow removal rates for 23 freshwater lakes, are generally lower for lakes of longer water residence time. The rate of accumulation is a measure of homeostatic response of the lake system to input load; it is equivalent to the rate of all the removal processes needed to maintain P concentration in the lake water at a steady state. (Author's abstract)
W89-00014

LAKE RESTORATION: WHY OXYGENATION AND ARTIFICIAL MIXING CANNOT SUBSTITUTE FOR A DECREASE IN THE EXTERNAL PHOSPHORUS LOADING,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
For primary bibliographic entry see Field 5G.
W89-00015

INTERNAL ELEMENTAL CYCLES AFFECTING THE LONG-TERM ALKALINITY STATUS OF LAKES: IMPLICATIONS FOR LAKE RESTORATION,
Freshwater Biological Association, Windermere (England).
For primary bibliographic entry see Field 5G.
W89-00016

STRATEGIES OF LAKE SANITATION,
Wahnbachtalsperrenverband, Siegburg (Germany, F.R.).
For primary bibliographic entry see Field 5G.
W89-00017

RESPONSE OF PHYTOPLANKTON COMMUNITIES TO CHANGING LAKE ENVIRONMENTS,
Freshwater Biological Association, Windermere (England).
C. S. Reynolds.
Schweizerische Zeitschrift fuer Hydrologie SZHYA6, Vol. 49, No. 2, p 220-236, August 1987. 5 fig, 1 tab, 54 ref.

Descriptors: *Lake restoration, *Limnology, *Eutrophic lakes, *Phytoplankton, *Algae, Biomass, Nutrients, Light penetration, Water depth, Species composition, Plant morphology, Plant physiology, Eutrophication, Adaptation, Limiting nutrients.

Empirical relationships between the mean phytoplankton biomass and limiting nutrient availability and between the underwater extinction of light and the biomass are used to define some of the physical aspects of lake environments subject to cultural eutrophication or to corrective restoration measures. The distinctive floristic distributions of different algae among such environments are closely related to general morphological and physiological properties of the algae themselves and that species sharing similar size- and shape-adaptations also share similar ecological growth and survival strategies. From these general predictions of the responses of phytoplankton to changing lake environments, it is deduced that deep lakes are slower to respond than shallow ones but that the transition between nutrient- and light-limitation is relatively abrupt: 'resilience' of the system to restoration measures may be an expression of their progress towards the transition. (Author's abstract)
W89-00018

FOOD WEB MANIPULATION WITHOUT NUTRIENT CONTROL: A USEFUL STRATEGY IN LAKE RESTORATION,
Technische Univ., Dresden (German D.R.). Sektion Wasserwesen.
For primary bibliographic entry see Field 5G.
W89-00019

CHEMICAL METHODS OF P-ELIMINATION IN THE TRIBUTARIES OF RESERVOIRS AND LAKES,
Wahnbachtalsperrenverband, Siegburg (Germany, F.R.).
For primary bibliographic entry see Field 5G.
W89-00020

EVALUATION OF LAKE RESTORATION IN SWEDEN,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
For primary bibliographic entry see Field 5G.
W89-00021

SEASONAL PRODUCTIVITY CYCLE OF PHYTOPLANKTON AND CONTROLLING FACTORS IN LAKE CONSTANCE,
Konstanz Univ. (Germany, F.R.). Limnological Inst.
M. M. Tilzer, and B. Beese.
Schweizerische Zeitschrift fuer Hydrologie SZHYA6, Vol. 50, No. 1, p 1-39, May 1988. 15 fig, 3 tab, 108 ref. Deutsche Forschungsgemeinschaft project No. Ti 115/10.

Descriptors: *Lake Constance, *Limnology, *Phytoplankton, *Switzerland, *Algae, *Aquatic productivity, Biomass, Seasonal variation, Water transparency, Sedimentation, Phosphorus, Photosynthesis, Vertical distribution, Light intensity, Eutrophic lakes, Lakes, Adaptation, Daylength, Thermal stratification, Shading effects.

Annual phytoplankton productivity in Lake Constance is about 300g C/sq m, a value typical for meso-eutrophic lakes. Seasonal variations in phytoplankton biomass and productivity are exceptionally great because of a sequence of factors controlling the production process. During winter productivity is controlled by low energy inputs and high respiratory losses due to deep water column mixing. Biomass is low and water transparency high. The spring phytoplankton growth is triggered by the thermal stabilization of the water column. The summer phytoplankton biomass maximum mainly depends on phosphorus availability. However, biomass yields comprise only 15-20% of values expected from the Redfield ratio because large proportions of particulate organic matter are detritus and non-algal biota. Moreover, sedimentation during the second half of the year removes biomass from the euphotic zone. Water transparency and thus vertical distribution of algal photosynthesis is highly dependent on phytoplankton biomass. Self-shading causes considerably smaller seasonal variations in areal biomass and photosynthetic rates than in volume-based values. Light-shade adaptation can compensate significantly for the effects of seasonal fluctuations in mean daily surface radiance fluxes on algal photosynthesis. At any given level of biomass daylength is the major determinant of daily production rates. (Author's abstract)
W89-00022

ORIGIN AND SIZE OF HYPOLIMNIC MIXING IN URNERSEE, THE SOUTHERN BASIN OF VIERWALDSTATTERSEE (LAKE LUCERNE),
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland). Inst. of Aquatic Sciences.
A. Wuest, D. M. Imboden, and M. Schurter.
Schweizerische Zeitschrift fuer Hydrologie SZHYA6, Vol. 50, No. 1, p 40-70, May 1988. 14 fig, 7 tab, 27 ref.

Descriptors: *Limnology, *Lake Lucerne, *Switzerland, *Lakes, *Hypolimnion, *Water exchange, *Water currents, Water temperature, Mixing, Wind-driven currents, Floods, Storms, Oxygen saturation, Heat transfer, Seasonal variation.

Urnersee and Gersauersee are 2 adjacent basins of Vierwaldstattersee separated by a sill of 85 m depth, with similar topography but remarkably different exposure to external factors such as wind and river input. Urnersee is exposed to diurnal winds and to occasional strong storms from the south (Fohn) whereas the wind over Gersauersee is moderate or weak. Two rivers, both having very large discharges during storms, replace the total water volume of Urnersee about once a year; in contrast, no large river flows directly into Gersauersee. Between March and October 1986, meteorological parameters, water temperatures and currents were measured quasi-continuously with the aim to quantify hypolimnic water exchange and mixing in Urnersee and to assess the relative importance of wind mixing versus river-induced water exchange for the renewal of the deep water layers. Three periods could be identified: (1) in April, weak stratification and strong episodic storms exchange about 50% of the deep hypolimnion (DH, defined as a layer below 110 m depth) leading to a mean heat flux of 36 W/sq m. Because of the large wind mixing the water of the exposed Urnersee below about 20 m depth becomes lighter than in the sheltered Gersauersee. (2) In May and June, the horizontal density gradient causes about 65% renewal of the Urnersee DH by the heavier Gersauersee intermediate water but does not affect the heat content. (3) Simultaneously with these processes are the episodic river floods adding another 20% to the DH water exchange and causing a heat flux of about 6 W/sq m. During the rest of the summer, water exchange remains below 10% and is mainly due to episodic flood while wind mixing has little influence. Yet, during floods water input into the DH per unit time can still be

very large and heat fluxes reach 600 W/sw m or more. The influence of lateral density currents between the two adjacent basins on hypolimnic mixing is of great ecological significance and explains the larger oxygen saturation found in the deep water of Urnersee compared to Gersauersee. (Author's abstract)
W89-00023

ROLE OF EXTERNAL AMMONIUM INPUTS IN FRESHWATER ACIDIFICATION,
Katholieke Univ. Nijmegen (Netherlands). Lab. of Aquatic Ecology.
For primary bibliographic entry see Field 5B.
W89-00024

DRIFT OF ZOOPLANKTON IN A LAKE-OUTLET (GLATT) IN A DAY-NIGHT-RHYTHM DEPENDING FROM THE WATER LEVEL,
Museo Cantonale di Storia Naturale, Lugano (Switzerland).
B. Jann, and H. Burgi.
Schweizerische Zeitschrift fuer Hydrologie SZHYA6, Vol. 50, No. 1, p 87-97, May 1988. 8 fig, 6 ref.

Descriptors: *Limnology, *Greifensee, *Switzerland, *Lakes, *Zooplankton, *Crustaceans, *Seston, *Aquatic drift, Species composition, Copepods, Daphnia, Water level, Glatt River, Animal behavior.

To give an indication of the influence of the dynamics and behavior of lake plankton on the seston composition in the outlet, four 24-hour sampling sessions were made in the Greifensee (situated near Zurich, Switzerland) and its outlet (River Glatt). The most important crustacean species studied were Eudiaptomus gracilis, Cyclops abyssorum, Cyclops vicinus, Mesocyclops leuckarti and Daphnia spp. Leptodora kindtii was found during one sampling only. No evidence of shore avoidance was found. The vertical migration in the lake, especially in the upper layer (0-6 m), is believed to have an influence on the amount of plankton which is flushed into the outlet. Although the composition and concentration of the plankton at the deepest point of the lake are known, no accurate predictions on the quality of the plankton close to shore or in the outlet were possible. (Author's abstract)
W89-00025

SPATIAL AND TEMPORAL VARIABILITY OF THE INDEX OF BIOTIC INTEGRITY IN THREE MIDWESTERN STREAMS,
Illinois Univ. at Urbana-Champaign. Dept. of Ecology, Ethology and Evolution.
For primary bibliographic entry see Field 2E.
W89-00026

INFLUENCE OF TEMPERATURE ON MICROHABITAT CHOICE BY FISHES IN A CALIFORNIA STREAM,
California Univ., Davis. Dept. of Wildlife and Fisheries Biology.
D. M. Baltz, B. Vondracek, L. R. Brown, and P. B. Moyle.
Transactions of the American Fisheries Society TAFSA I, Vol. 116, No. 1, p 12-20, January 1987. 3 fig, 5 tab, 19 ref.

Descriptors: *Fish behavior, *Aquatic habitats, *Streams, *Instream flow, *Mathematical models, *Temperature effects, Water depth, Flow velocity, Surface velocity, Substrates, California, Statistics, Discriminant analysis.

Eight microhabitat variables were used to examine the assumption that the variables normally included in instream flow studies are adequate to discriminate among species' microhabitats. When 8 variables were available in stepwise-discriminant analysis models to distinguish among the microhabitats of 4 fish species in a northern California stream, the variance explained ranged from 52-77% and 59-86% of the observational records were correctly classified to species. The variables measured were temperature, total depth, focal point elevation (distance of fish from the bottom), focal point velocity (water velocity at fish's snout), mean water column velocity, surface velocity, substrate, and cover. When the number of variables available was reduced to the 3 normally used in instream flow studies (i.e. total depth, mean column water velocity, and substrate), the variance explained ranged from 0-20%, and 46-55% of the observational records were correctly classified to species. When all 8 variables were available, 2 variables not normally measured in instream flow studies, temperature and focal point elevation, were important in discriminating among species. Focal point elevation explained between 32-43% of the variance in the 5 models in which it was available. Temperature was included in 14 of 15 models in which it was available and made significant contributions in 12. Total depth was included and significant in 12 of the 20 models in which it was available. When total depth was included in a model, it was always more important than temperature; however, temperature and focal point elevation were the only significant variables on 2 sampling dates. Mean water column velocity and substrate only made minor contributions in a few of the 20 models in which they were available. (Author's abstract)
W89-00027

TUMOR FREQUENCIES AND CONTAMINANT CONCENTRATIONS IN BROWN BULLHEADS FROM AN INDUSTRIALIZED RIVER AND A RECREATIONAL LAKE,
National Fisheries Contaminant Research Center, Columbus, OH. Field Research Station.
For primary bibliographic entry see Field 5C.
W89-00028

LONGITUDINAL CHANGES IN FISH ASSEMBLAGES AND WATER QUALITY IN THE WILLAMETTE RIVER, OREGON,
Northrop Services, Inc., Corvallis, OR.
R. M. Hughes, and J. R. Gammon.
Transactions of the American Fisheries Society TAFSA I, Vol. 116, No. 2, p 196-209, March 1987. 8 fig, 5 tab, 40 ref. U.S. Environmental Protection Agency Contract 68-03-3124.

Descriptors: *Fish populations, *Rivers, *Water quality, *Willamette River, *Oregon, *Water pollution effects, Index of biotic integrity, Index of well being, Aquatic habitats, Stream order.

A survey of the fish assemblages between river kilometer 283 and 2 of the mainstem Willamette River was conducted in 1983 to evaluate the effects of improved water quality on longitudinal changes in fish assemblages and the usefulness of 2 indices of fish assemblage quality (index of well being and index of biotic integrity). Physical and chemical habitat quality and fish assemblage quality showed gradual, similar, and expected declines from the upper to the lower river, with only small changes near large point sources of pollution. More fish species, more species intolerant of poor habitat quality, and fewer species tolerant of poor habitat occurred in 1983 than in 1945. Stream order did not predict fish assemblage patterns. A modification of the index of biotic integrity appeared to reflect changes in fish assemblage patterns and habitat quality better than the index of well being. (Author's abstract)
W89-00029

EUTROPHICATION EFFECTS OF PREY SIZE AND FOOD AVAILABLE TO YELLOW PERCH IN LAKE ERIE,
Ohio Cooperative Fishery Research Unit, Columbus.
For primary bibliographic entry see Field 5C.
W89-00030

FEEDBACK DEPENDENCE BETWEEN THE EUTROPHICATION PROCESS AND CHANGES IN THE FISH COMMUNITY: THE THEORY OF ICHTHYOEUTROPHICATION (SPRZEZENIE ZWROTHE MIEDZY PROCESUM EUTROFIZACJI A ZMIANAMI ZESPOLU RYB. TESRI ICHTIOEUTROFIZACJI),
Instytut Rybactwa Srodladowego, Piaseczno (Poland). Zabieniec Centre.
For primary bibliographic entry see Field 5C.
W89-00031

NATURAL DEGRADATION ABILITY OF LAKES AND THE ROLE OF DRAINAGE AREA IN THE PROCESS (OCENA NATURALNEJ PODATNOSCI JEZIOR NA DEGRADACJE I ROLA ZLEWNI U TYM PROCESIE),
Warsaw Univ. (Poland). Inst. of Physical Geographic Sciences.
E. Bajkiewicz-Grabowska.
Wiadomosci Ekologiczne WEKLAP, Vol. 33, No. 3, p 279-289, 1987. 2 fig, 6 tab, 9 ref. English summary.

Descriptors: *Lakes, *Lake classification, *Eutrophication, *Erosion, *Water pollution sources, Water exchange, Epilimnion, Poland, Nonpoint pollution sources, Pollution index, Limnology, Catchment areas.

A modification of two systems: natural degradation ability and impact of drainage area on matter supply to the lake. The drainage area considered includes both the influence of total and direct drainage areas. It was estimated according to: Ohle's index, type of water balance, share of depressions in the direct drainage area, its average slope, mean density of channel network density, geology and land use. Land capability was classified from 0 (restricted influence) to 3 points (great influence), depending on its influence concerning mobilizing pollutants in the drainage area and supplying them to the lake. The susceptibility of the lake to external factors was estimated according to: mean depth, quotient of lake volume and its shoreline length, percent of thermal stratification, quotient of bottom surface within epilimnion and epilimnion volume, rate of annual water exchange, Schindler's index. The effect of particular characteristics on lake degradation is determined by points from 0 (resistant to external influence) to 3 (not resistant). The arithmetic mean of the number of points from estimations of the lake's resistance to degradation is the final result. When it is equal to or less than 0.8, the lake is resistant to external factors; at 0.9-1.6 it shows an average resistance to external factors, at 1.7-2.4 a small resistance; and over 2.4 great dependence on external factors. This is an estimation on the example of 23 lakes from north-eastern Poland. The analysis of data distinguished 4 groups of drainage area-lake systems, varying in their degradation ability. (Author's abstract)
W89-00032

SIMPLE SELF-ACTING HYDROBIOLOGICAL SAMPLER (PROSTY SAMOCZYNNY CZERPACZ HYDROBIOLOGICZNY),
Wyzsza Szkola Pedagogiczna, Olsztyn-Kortow (Poland).
For primary bibliographic entry see Field 7B.
W89-00033

PARTICULATE CONCENTRATIONS IN LAKE ST. CLAIR AS RECORDED BY A SHIPBORNE MULTISPECTRAL OPTICAL MONITORING SYSTEM,
National Water Research Inst., Burlington (Ontario). Rivers Research Branch.
For primary bibliographic entry see Field 7B.
W89-00066

EFFECT OF A HEATED WASTEWATER DISCHARGE UPON RIVER PROTOZOAN SPECIES POOL VARIABILITY THROUGH TIME AND SPACE,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W89-00077

STUDY OF THE TEMPERATURE DEPENDENCE OF THE ACUTE TOXICITY OF PEN-

TACHLOROPHENOL TO A FRESHWATER POND SNAIL, VIVIPARUS BENGALENSIS L.,
K.L.D.A.V. Coll., Roorkee (India). Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W89-00078

PESTICIDAL EFFECTS ON CHIRONOMID LARVAE,
Udaipur Univ. (India). Dept. of Limnology and Fisheries.
For primary bibliographic entry see Field 5C.
W89-00079

DEVELOPMENT OF MICROORGANISMS ON THE BACKGROUND OF ORGANIC MATTER IN FOREST ECOSYSTEM WATERS,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
T. Bednarz, K. Trela, and J. Zygmuntowa.
Ekologia Polska ELPLBS, Vol. 35, No. 2, p 247-270, 1987. 10 fig, 2 tab, 27 ref.

Descriptors: *Organic matter, *Microbiological studies, *Ecosystems, *Forest watersheds, *Bacterial analysis, *Algae, Watersheds, Humic acids, Water analysis, Proteins, Bacteria, Heterotrophic bacteria, Groundwater, Surface water, Bacterial physiology, Iron, Heavy metals, Nutrients, Populations, Chlorella, Chlorophyta, Sulfates, Niepolomice Forest, Poland, Ecology.

Streams of the Niepolomice Forest (Poland) are divided into a fertile outer part and a less fertile inner part. Bacteriological and algological studies were undertaken to study this phenomenon. Surface and groundwaters were also analyzed for total dissolved organic matter, protein, and humic compounds. The poor growth of algae in the central part of the forest is due to physiological inaccessibility of iron occurring in a form bound with humic compounds. Mineral nutrients reaching bottom sediments are irrevocably lost for algae, and organic matter deposited in sediments is not available for bacteria. Organic matter content and studies of the growth of different physiological groups of bacteria show that the groundwaters of the forest are also divided into a central and outer part. An abundance of sulfates was found in surface and groundwaters at all sampling stations, probably resulting from atmospheric industrial emissions. (Doria-PTT)
W89-00080

EFFECTS OF FISH NESTS ON PATTERN AND ZONATION OF SUBMERSED MACROPHYTES IN A SOFTWATER LAKE,
Notre Dame Univ., IN. Dept. of Biology.
S. R. Carpenter, and N. J. McCreary.
Aquatic Botany AQBODS, Vol. 22, No. 1, p 21-32, June 1985. 5 fig, 3 tab, 32 ref.

Descriptors: *Lakes, *Fish, *Nesting, *Submerged plants, *Macrophytes, *Oligotrophic lakes, Sunfish, Aquatic plants, Elatine, Isoetes, Fish behavior, Vegetation establishment, Spores, Distribution patterns, Ecosystems.

Nests of centrarchid fishes maintain patches of diaspore-propagated submersed aquatic plants (principally Elatine minima and Isoetes braunii) between 0.9 and 2.4 m depth in a softwater oligotrophic lake. Nests are cleared of vegetation in May-June, and abandoned by fish in June. By August, many nests are colonized by diaspore-propagated species that do not spread vegetatively on horizontal stems. About 75% of the nests are reoccupied by fish the following May, and some new nests are formed. Nests not reoccupied by fish are colonized by rhizomatous plants of 4 species that have not been observed to flower or set seed in the lake. Rhizomatous plants reach frequencies near 100% by 14 months after abandonment. Pattern analyses show that patch sizes of diaspore-propagated species correspond to the size of fish nests. Conventional explanations of macrophyte zonation based on depth, exposure, and competition are insufficient in this lake; effects of disturbance must be considered as well. (Author's abstract)
W89-00092

BIOMASS AND NUTRITIVE POTENTIAL OF VALLISNERIA AMERICANA MICHX IN NAVIGATION POOL 9 OF THE UPPER MISSISSIPPI RIVER,
Wisconsin Univ.-La Crosse. River Studies Center.
G. N. Donnermeyer, and M. M. Smart.
Aquatic Botany AQBODS, Vol. 22, No. 1, p 33-44, June 1985. 3 fig, 3 tab, 20 ref.

Descriptors: *Rivers, *Submerged plants, *Biomass, *Nutrition, Vallisneria, Aquatic productivity, Plant physiology, Plant growth, Plant morphology, Leaves, Roots, Dry matter, Moisture content, Protein, Seasonal variation, Mississippi River, Ducks, Waterfowl.

Vallisneria americana (wild celery) was studied to determine the biomass and nutritive potential of all morphological structures. A 2.6-ha stand of uniform V. americana was sampled during the summer and autumn of 1980, and the spring and summer of 1981 in the southern portion of Navigation Pool 9 which is utilized by approximately 75% of the North American canvas back ducks. The maximum production rate of 3.2 g/sq m/day was coincident with rapid rosette production and flowering, and occurred mid- to late-July 1980. The maximum biomass of 217.3 g dry wt./sq m was on 1 September 1980, when fruit development was also at a maximum. Leaves composed 60-70% of the summer biomass; winter buds constituted all of the winter biomass. Winter buds and fruits had the greatest nutritive potentials. Both organs contained relatively high dry-matter concentrations and were low in ash (less than 10%) and fiber content. The potentially-digestible ash-free non-cell-wall fraction was composed of an average of 75.7 and 82.2% of the dry weight of fruits and winter buds, respectively. In contrast, the nutritive potential of leaves, rootstocks, peduncles, and stolons was reduced because of high moisture (less than 8% dry matter), ash and fiber concentrations. Staminate inflorescences and pistillate flowers were high in crude protein (averaged 21.8% and 16.1% of the dry weight, respectively) and ash-free non-cell-wall fractions, but they accounted for only 2.7% of the plant biomass. The maximum calorific content of V. americana was approximately 3200 kJ per sq m at peak biomass on 1 September 1980. (Author's abstract)
W89-00093

PHOTOSYNTHESIS OF SUBMERSED MACROPHYTES IN ACIDIFIED LAKES: II. CARBON LIMITATION AND UTILIZATION OF BENTHIC CO2 SOURCES,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
For primary bibliographic entry see Field 5C.
W89-00095

EFFECTS OF THE SEASON AND OF WATER CHEMISTRY ON THE DECOMPOSITION OF NYMPHAEA ALBA L.: WEIGHT LOSS AND PYROLYSIS MASS SPECTROMETRY OF THE PARTICULATE MATTER,
Katholieke Univ. Nijmegen (Netherlands). Lab. of Aquatic Ecology.
T. C. M. Brock, J. J. Boon, and B. G. P. Paffen.
Aquatic Botany AQBODS, Vol. 22, No. 3/4, p 197-229, September 1985. 10 fig, 9 tab, 44 ref.

Descriptors: *Lakes, *Decomposition, *Decomposing organic matter, *Aquatic plants, *Nymphaea, *Water pollution effects, Mass spectrometry, Temperature effects, Chemical properties, Particulate matter, Carbohydrates, Eutrophication, Hydrogen ion concentration, Acidity, Alkalinity, Leaves, Mineralization.

Dynamics in loss of mass and changes in organic matter composition of decomposing leaves of Nymphaea alba were studied in the ambient water of an alkaline eutrophic oxbow lake and an acid moorland pool. These aspects were also studied in the laboratory, in open flow-through aquaria fed with media differing in pH, alkalinity and nitrogen and/or phosphorus concentrations. The loss in weight of the decomposing leaves was studied using litter bags. The organic matter composition of the particulate residues was characterized by Curie-point pyrolysis mass spectrometry. Higher weight-loss rates and faster changes in organic matter composition were observed in the warmer period of the year and under more eutrophic and/or alkaline conditions. In acid environments, the loss of structural carbohydrates from the decomposing plant material was small. In eutrophic and/or alkaline environments, lignin accumulated in the particulate residues, while cellulose and hemicellulose were apparently mineralized. (Author's abstract)
W89-00096

BIOMASS PRODUCTION AND NUTRIENT CYCLING IN AQUATIC MACROPHYTE COMMUNITIES OF THE CHOWAN RIVER, NORTH CAROLINA,
East Carolina Univ., Greenville, NC. Dept. of Biology.
R. R. Twilley, L. R. Blanton, M. M. Brinson, and G. J. Davis.
Aquatic Botany AQBODS, Vol. 22, No. 3/4, p 231-252, September 1985. 5 fig, 5 tab, 42 ref. Water Resources Research Institute of the University of North Carolina Grant B-079-NC.

Descriptors: *Stream biota, *Biomass, *Primary productivity, *Cycling nutrients, *Macrophytes, Aquatic plants, Rivers, Plant populations, Justicia, Nuphar, Standing crops, Mortality, Plant morphology, Iron, Calcium, Nitrogen, Detritus, Bottom sediments, Chowan River, North Carolina.

Net primary productivity of Justicia americana was estimated at 173 g dry wt./cu m/growing season, based on the difference between maximum and minimum standing crops. For Nuphar luteum, the great variation in biomass estimates and observed high mortality of floating leaves during the growing season resulted in an underestimate of net production using this approach. Estimates based on tagging experiments were 222 g dry wt./sq m/yr using annual turnover rates, compared to 234 g dry wt./sq m/yr using monthly rates. Nearly 92% of this net production was accounted for by above-ground structures, although they represented only 33% of the biomass at any one time. Nutrient distributions in both species differed spatially and seasonally for each plant structure, which suggests that accurate estimates of nutrient turnover would have been masked by whole plant analyses. Most notable were high affinities of iron in below-ground structures and calcium and nitrogen in above-ground structures for both species. One-half the dry mass of above-ground structures was lost from mesh bags in only 7 days for N. luteum compared to 60 days for J. americana, indicating the high recycling potential of aquatic plant detritus. Nutrient immobilization during decomposition was minor except for calcium and magnesium in above-ground structures of J. americana. Highest nutrient turnover rates were for nitrogen and potassium at about 7.5 g/sq m/yr in N. luteum and nutrient turnover rates for the floating-leaf macrophyte were higher than for the emergent macrophyte. Assuming that most of these nutrients originated from the sediments, these turnover rates represent significant fluxes of nutrients to the water column. (Author's abstract)
W89-00097

INFLUENCE OF SEDIMENT COMPOSITION AND IRRADIANCE ON THE GROWTH AND MORPHOLOGY OF MYRIOPHYLLUM SPICATUM L.,
McGill Univ., Montreal (Quebec). Dept. of Biology.
P. A. Chambers, and J. Kalff.
Aquatic Botany AQBODS, Vol. 22, No. 3/4, p 253-263, September 1985. 4 fig, 3 tab, 32 ref.

Descriptors: *Limnology, *Bottom Sediments, *Lakes, *Solar radiation, *Aquatic plants, *Plant growth, Plant morphology, Myriophyllum, Water depth, Biomass, Sand, Distribution patterns, Statistical analysis, Quebec, Vermont.

Maximum summer biomass and morphology of Myriophyllum spicatum were influenced by both sediment composition and irradiance. Plants were grown in Lake Memphremagog, Quebec-Vermont along a natural depth gradient (1.5, 2, and 3 m) in buckets containing 100% fertile marsh sediment, 10% marsh sediment:90% sand, or 100% sand. Shoot biomass responded to changes in sediment composition regardless of water depth. However, irradiance responses occurred only in the 100% marsh sediments. While sediment composition, irradiance and their interaction explained 91% of the total experimental variation, approximately 75% of the shoot biomass variation was attributable to sediment composition alone. Depth and the interaction term were each responsible for only 8%. These results appear consistent with both the morphology and natural distribution of M. spicatum. (Author's abstract)
W89-00098

HIGH RATES OF PRODUCTION AND MORTALITY OF SUBMERGED SPARGANIUM EMERSUM REHMAN DURING ITS SHORT GROWTH SEASON IN A EUTROPHIC DANISH STREAM,
Copenhagen Univ., Hilleroed (Denmark). Det Ferskvands-Biologiske Lab.
L. W. Nielsen, K. Nielsen, and K. Sand-Jensen.
Aquatic Botany AQBODS, Vol. 22, No. 3/4, p 325-334, September 1985. 3 fig, 2 tab, 11 ref.

Descriptors: *Stream biota, *Mortality, *Aquatic plants, *Submerged plants, *Sparganium, *Eutrophication, Rivers, Plant growth, Streams, Stream discharge, Plant populations, Plant morphology, Biomass, Standing crops, Leaves, Temperate zone, Denmark.

Above-ground production and mortality of Sparganium emersum were investigated during its summer growth season, when water discharge is low, in the Danish lowland stream, River Susa. Production and mortality followed the same seasonal pattern with a time-lag for mortality of about 1 month. The lifetime of individual leaves was only from 31 to 39 days. In one population, the mortality rate constituted more than 50% of the production rate before the maximum biomass was attained. This mortality was mainly due to a successive loss of individual, old leaves, and loss of entire shoots was small until late in the season. Ratios of annual production to maximum standing crop were from 2.2 to 2.4 and therefore, standing crop cannot be used as a measure for annual production. The maximum daily production rates were from 4 to 6% of the biomass in late June and mean rates for the growth season were from 2.5 to 2.7%/day. The maximum daily productivity ranged from 11.5 to 15.4 g dry wt./sq m and the annual production realized during 5 months was from 500 to 1000 g dry wt./sq m. These values show that leaf growth and leaf mortality of Sparganium emersum are concurrent and rapid processes in eutrophic, temperate streams. (Author's abstract)
W89-00099

BIOMASS, PRODUCTIVITY AND LIFE HISTORY TRAITS OF JUNCUS MILITARIS BIGEL. IN TWO RHODE ISLAND (U.S.A.) FRESHWATER WETLANDS,
Rhode Island Univ., Kingston. Dept. of Botany.
A. M. Hogeland, and K. T. Killingbeck.
Aquatic Botany AQBODS, Vol. 22, No. 3/4, p 335-346, September 1985. 3 fig, 2 tab, 31 ref.

Descriptors: *Wetlands, *Biomass, *Productivity, *Life history studies, *Limnology, *Aquatic plants, *Juncus, Lakes, Lentic environment, Water depth, Limiting nutrients, Nitrogen, Seasonal variation, Plant morphology, Leaves, Vascular tissues, Submerged plants, Rhode Island.

Above-ground and below-ground production of Juncus militaris, a freshwater emergent macrophyte, was measured in two lacustrine stands. Emergent shoot biomass was highest in late summer or early fall at both sites (305 and 437 g/sq m). Submergent leaves were present from late fall to early summer, yet the biomass they contributed (68 and 55 g/sq m) was much lower than that of below-ground biomass (528 and 1014 g/sq m) at both sites. Maximum shoot densities at the two sites were not significantly different (672 and 655 shoots/sq m). Net emergent productivity was 387 and 485 g/sq m/yr. The emergence of J. militaris shoots in two cohorts that had significantly different maximum heights, growth and inflorescence production caused the bimodality in the seasonal distribution of emergent productivity. Submergent productivity was 68 and 55 g/sq m/yr, belowground productivity was 244 and 587 g/sq m/year and total productivity was 698 and 1127 g/sq m/yr. Water depth appeared to be a major factor affecting interstand difference in emergent shoot production, heights and lengths of inflorescences, and delays in senescence. Substratum nutrient content, particularly low ammonium-nitrogen concentrations, may have been responsible for interstand differences in below-ground biomass. The submergent and emergent life forms of J. militaris displayed a distinct phenological dichotomy that may be partially responsible for the competitive success of this species. (Author's abstract)
W89-00100

LEAF PRODUCTION AND NITROGEN AND PHOSPHORUS TISSUE CONTENT OF LITTORELLA UNIFLORA (L.) ASCHERS. IN RELATION TO NITROGEN AND PHOSPHORUS ENRICHMENT OF THE SEDIMENT IN OLIGOTROPHIC LAKE HAMPEN, DENMARK,
Aarhus Univ. (Denmark). Botanical Inst.
For primary bibliographic entry see Field 5C.
W89-00101

RICHNESS OF AQUATIC MACROPHYTE FLORAS OF SOFT WATER LAKES OF DIFFERING PH AND TRACE METAL CONTENT IN ONTARIO, CANADA,
Ontario Ministry of the Environment, Dorchester. Dorset Research Center.
For primary bibliographic entry see Field 5C.
W89-00103

EFFECTS OF A CYPERUS PAPYRUS L. SWAMP ON DOMESTIC WASTE WATER,
Mwanza Fisheries Research Centre (Tanzania).
For primary bibliographic entry see Field 5D.
W89-00107

EFFECTS OF GRAZERS AND LIGHT PENETRATION ON THE SURVIVAL OF TRANSPLANTS OF VALLISNERIA AMERICANA MICHX IN THE TIDAL POTOMAC RIVER, MARYLAND,
Geological Survey, Reston, VA.
V. Carter, and N. B. Rybicki.
Aquatic Botany AQBODS, Vol. 23, No. 3, p 197-213, December 1985. 4 fig, 7 tab, 26 ref.

Descriptors: *Light penetration, *Survival, *Tidal rivers, Submerged plants, Vallisneria, Aquatic plants, Macrophytes, Estuaries, In situ tests, Leaves, Secchi disks, Transparency, Potomac River, Maryland.

Poor light penetration and grazing are among the factors potentially responsible for the lack of submersed aquatic macrophytes in the tidal Potomac River. Between 1980 and 1983, plugs, sprigs, and tubers of Vallisneria americana were transplanted from the oligohaline Potomac Estuary to six sites in the freshwater tidal Potomac River. Transplants made in 1980 and 1981 were generally successful only when protected by full exclosures which prevented grazing. Grazing resulted in the removal of whole plants or clipping off of plant leaves in unprotected plots. Plants protected in the first year were permanently established, despite the occurrence of grazing in subsequent years, at Elodea Cove and Rosier Bluff, where light penetration was high (average 1% light level was 1.6-1.7 m). Plants were not permanently established at Goose Island, where light penetration was lower (average 1% light level was 1.4 m) and grazing occurred, or Neabsco Bay where light penetration was very low (average 1% light level was 1.0 m) and grazing may not have occurred. In 1983, Secchi depth transparencies in the upper tidal river were improved significantly compared to 1978-1981. Both protected and unprotected transplants thrived in 1983. (See also W89-00114) (Author's abstract)
W89-00108

EQUATIONS RELATING GROWTH AND UPTAKE OF NITROGEN BY SALVINIA MOLESTA TO TEMPERATURE AND THE AVAILABILITY OF NITROGEN,
Commonwealth Scientific and Industrial Research Organization, Indooroopilly (Australia). Long Pocket Labs.
P. M. Room.
Aquatic Botany AQBODS, Vol. 24, No. 1, p 43-59, March 1986. 5 fig, 1 tab, 30 ref.

Descriptors: *Plant Growth, *Nitrogen, *Aquatic weeds, *Temperature effects, *Nutrient requirements, Mathematical equations, Salvinia, Growth rates, Wastewater lagoons, Limiting nutrients, Statistical analysis, Prediction, Nitrogen fixation, Plant physiology, Absorption.

Equations for predicting rates of growth, nitrogen content, and rates of nitrogen uptake in Salvinia molesta were derived from the literature and from new experiments. Equations for the effects of temperature specified zero growth below 5 C and above 43 C, with an optimum at 30 C and are applicable over a wider range than an Arrhenius model. They explained 74 and 55% of the variance in growth in numbers of leaves and weight, respectively, in a sewage lagoon where nutrients should not have been limiting. Equations for the effects of nitrogen content of the plant specified a four-fold, asymptotic increase in growth between 0.8% N and maximum growth above 5.0% N. Predictions from nitrogen contents explained 41% of the variance in growth in numbers of leaves in Papua New Guinea where temperatures fluctuated little. Top to root ratios rose from near 1.5 at 1% N to near 6.0 at 5% N. Rates of nitrogen uptake followed trends similar to rates of growth, and nitrogen fixation supported a low rate of growth in the absence of nitrogen in solution. (See also W89-00106 and W89-00113) (Author's abstract)
W89-00111

NITROGEN, PHOSPHORUS AND POTASSIUM IN SALVINIA MOLESTA MITCHELL IN THE FIELD; EFFECTS OF WEATHER, INSECT DAMAGE, FERTILIZERS AND AGE,
Commonwealth Scientific and Industrial Research Organization, Indooroopilly (Australia). Div. of Entomology.
P. M. Room, and P. A. Thomas.
Aquatic Botany AQBODS, Vol. 24, No. 3, p 213-232, June 1986. 6 fig, 5 tab, 36 ref.

Descriptors: *Aquatic plants, *Aquatic weeds, *Nutrients, *Nitrogen, *Phosphorus, *Potassium, Floating plants, Salvinia, Rainfall, Runoff, Temperature, Seasonal variation, Insect behavior, Food habits, Cyrtobagous, Aquatic weed control, Biocontrol, Fertilization, Ureas, Phosphates, Life cycles, Aging, Plant tissues, Roots, Australia, Papua New Guinea.

More than 1700 samples of Salvinia molesta were collected from sites distributed from close to the equator in Papua New Guinea to 33 degrees S in Australia. Nitrogen content ranged from 0.62 to 4.0% dry weight, phosphorus from 0.03 to 1.07% and potassium from 0.31 to 5.32%. Tops contained more concentrated N and P than roots, while K was more concentrated in roots. Concentrations of N and P were significantly correlated. Rainfall, followed by runoff, resulted in peaks of N, P, and K in plants in one lake, but the sequence could not be demonstrated at other sites. At sites experiencing marked seasonal changes in temperature, N and P contents were inversely correlated with temperature, probably due to greater growth and utilization of nutrients in summer. Damage caused by the biological control agent Cyrtobagous salviniae decreased K content, while N and P contents were increased in some cases, but not in others. Thick mats of S. molesta in Papua New Guinea contained less concentrated N and P than thin mats, but this was not necessarily the case in the Australian sites.

The reasons for these differences, and the likely effects on biological control agents, are discussed. Urea and superphosphate were found to increase N and P concentrations in the plant by amounts useful for experimental purposes and for aiding establishment of biological control agents. An equation related N concentration to the amount of urea applied and background N content of the plant. Concentrations of N, P, and K decreased with age. Levels of N and P dropped most quickly as buds opened, then dropped slowly until the onset of senescence caused another rapid decline. The implications of these changes for insects feeding on S. molesta are discussed. (See also W89-00106 and W89-00111) (Author's abstract)
W89-00113

EFFECT OF SEDIMENT DEPTH AND SEDIMENT TYPE ON THE SURVIVAL OF VALLISNERIA AMERICANA MICHX GROWN FROM TUBERS,
Geological Survey, Reston, VA.
N. B. Rybicki, and V. Carter.
Aquatic Botany AQBODS, Vol. 24, No. 3, p 233-240, June 1986. 5 fig, 19 ref.

Descriptors: *Estuaries, *Tidal rivers, *Aquatic plants, *Sedimentation, *Plant growth, *Sediments, *Storm runoff, Vallisneria, Wild celery, Survival, Roots, Sand, Silt, Potomac River.

Sedimentation resulting from storms may have been one of the reasons for the elimination of submersed aquatic vegetation from the tidal Potomac River in the late 1930s. Laboratory studies were conducted to investigate the effects of different depths of overlying sediment and composition of sediment on the survival of Vallisneria americana Michx (wild celery) grown from tubers. Survival of plants grown from tubers decreased significantly with increasing sediment depth. Survival of tubers declined from 90% or more when buried in 10 cm to no survival in greater than 25 cm of sediment. Survival with depth in sand was significantly lower than in silty clay. Field investigation determined that the majority of tubers in Vallisneria beds are distributed between 10 and 20 cm in depth in silty clay and between 5 and 15 cm in depth in sand. Based on the field distribution of tubers and on the percent survival of plants growing from tubers at each depth in the laboratory experiment, we suggest that the deposition of 10 cm or more of sediment by severe storms such as occurred in the 1930s could contribute to the loss of vegetation in the tidal Potomac River. (See also W89-00108) (Author's abstract)
W89-00114

TROPICAL WETLANDS AS A CARBON SOURCE,
North Carolina Univ. at Wilmington. Dept. of Biological Sciences.
A. A. de la Cruz.
Aquatic Botany AQBODS, Vol. 25, No. 2, p 109-115, September 1986. 4 tab, 15 ref. NSF Grants INT-8313694 and BSR-8408299.

Descriptors: *Wetlands, *Carbon, *Nutrients, *Tropical regions, *Carbon cycle, Exploitation, Drainage effects, Peat bogs, Mangrove swamps.

Wetlands have long been recognized as a carbon sink, and a suggestion has been made that this may have served in the past several centuries to balance out releases from reduction of forests in the world. Cultural exploitation of wetland areas, such as excavation during exploration for fossil fuel and minerals, draining for farming of grain and fiber and production of animal protein, invariably results in the oxidation of the carbon storage sink. Destructive wetland alterations which reduce or remove the vegetative cover also decrease the fixation of atmospheric carbon, thus resulting in a net carbon release from wetlands. Wetland excavation for peat extraction is estimated to oxidize 472 metric tons of stored carbon per 1000 metric tons of dry peat combusted, while 375 metric tons of carbon are released from one hectare of mangrove swamp cleared and dug out for fish pond construction. Increasing and widespread alterations of this nature convert wetlands to a carbon source and could therefore play a significant role in the global cycle of carbon. (Author's abstract)
W89-00118

NUTRIENT DYNAMICS IN MINEROTROPHIC PEAT MIRES,
Utrecht Rijksuniversiteit (Netherlands). Dept. of Plant Ecology.
J. T. A. Verhoeven.
Aquatic Botany AQBODS, Vol. 25, No. 2, p 117-137, September 1986. 5 tab, 77 ref.

Descriptors: *Wetlands, *Cycling nutrients, *Nitrogen, *Phosphorus, *Potassium, Literature review, Rainfall, Influent streams, Groundwater movement, Hydrologic properties, Mineral water, Aquatic plants, Decomposition, Mineralization, Nitrogen fixation, Denitrification, Limiting nutrients, Peat soil, Fens, Swamps.

The literature on the dynamics of nitrogen, phosphorus, and potassium in minerotrophic mires was reviewed. Minerotrophic mires are wetlands with a peat soil of more than 40 cm thick, which receive water and nutrients not only from precipitation, but also from inflowing streams and groundwater. Typical examples of such mires are fens, Papyrus swamps, and Cladium mires. In a hydrological gradient from peat bogs with no lateral water movement to lentic riverine wetlands with strong currents, minerotrophic mires are intermediate. They are of two main types: quaking mires with a floating mat of vegetation on top of a water layer, and mires with a continuous peat layer down to the bottom sediment or bedrock. The mire water is a mixture of rainwater and groundwater. Calcium is the most predominant cation, bicarbonate or sulfate the predominant anions. The peat soil of the mires contains large amounts of N, P, and K. The concentrations of N, P, and K measured by different authors in a wide variety of mires fall within remarkably narrow ranges. 'Available' N and P amount to only 0.6-1.2% and 0.2-3% of the total, respectively. The availability of N and P to the vegetation is determined by the mineralization of organic matter and by the supplies in rain and groundwater. The processes of decomposition and mineralization in mires are discussed in some depth. The fixation of gaseous N by bacteria is a significant N input to minerotrophic mires. The circumstances for denitrification are very suitable, but the actual rates are probably low due to the scarcity of NO3(-). The role of vegetation in the nutrient dynamics of mires is discussed. In many minerotrophic mires plant growth is limited by the availability of N or P. A qualitative picture is given of the inputs and outputs of N, P, and K in minerotrophic mires. The nutrient stocks in three compartments--water, peat soil, and vegetation--are given for three mire systems in different parts of the world. (Author's abstract)
W89-00119

SOURCES AND FATE OF DETRITUS IN THE SHORE ZONE OF LAKES,
Warsaw Univ. (Poland). Dept. of Hydrobiology.
E. Pieczynska.
Aquatic Botany AQBODS, Vol. 25, No. 2, p 153-166, September 1986. 5 fig, 4 tab, 60 ref.

Descriptors: *Lakes, *Lake shores, *Littoral environment, *Detritus, *Limnology, *Decomposition, Litter, Hydrophytes, Feces, Animal behavior, Poland.

The origin, distribution, and decomposition of detritus are discussed in relation to the functioning of the lake littoral. As examples, data from several years of study on the Masurian Lakes (northern Poland) are presented. Different sites (even within one lake) vary visibly as to the significance of autochthonous and allochthonous detritus. Terrestrial leaf litter and hydrophyte remains accumulate in great amounts and are important for the spatial structure of habitats. The decomposition rate of dead plants and animals and of their remains (up to their total disappearance) ranges from < 10 days (algae, animal tissues) to > two years (leaf litter, reed shoots). The intensity of decomposition is greatly influenced by environmental conditions within the littoral zone. Animal activity is significant in the formation and processing of detritus (production of feces and breaking down of large particles by shredders are the most important factors). (Author's abstract)
W89-00121

PEATLAND SOIL-PLANT RELATIONSHIPS IN THE NEW FOREST,
Southampton Univ. (England). Dept. of Geography.
M. J. Clarke, and R. H. Allen.
Aquatic Botany AQBODS, Vol. 25, No. 2, p 167-177, September 1986. 5 fig, 2 tab, 24 ref.

Descriptors: *Wetlands, *Peat soil, *Aquatic plants, *Hydrologic budget, Conservation, Drainage basins, Soil water, England.

The valley mires of England's New Forest are of international importance to conservation. Their effective ecological management requires an understanding of the valley mire water budget. The soil-vegetation relationships within a peatland catchment are described, and mire community structure is explored by quantitative techniques and compared with soil properties. A soil water regime model, based on profile morphology, is presented for New Forest mires applicable to different plant communities. The identification of water sources around valley mires is an essential prerequisite for the development of a conservation strategy. (Author's abstract)
W89-00122

USE OF MIRES IN MONITORING THE ATMOSPHERIC DEPOSITION OF HEAVY METALS,
National Water Research Inst., Burlington (Ontario). Aquatic Ecology Div.
For primary bibliographic entry see Field 5A.
W89-00123

PATTERNS OF TEMPERATURE AND HUMIDITY IN WETLAND BIOTOPES,
Ceskoslovenska Akademie Ved, Trebon. Dept. of Hydrobotany.
K. Priban, J. P. Ondok, and J. Jenik.
Aquatic Botany AQBODS, Vol. 25, No. 2, p 191-202, September 1986. 12 fig, 21 ref.

Descriptors: *Wetlands, *Temperature, *Humidity, Artificial Lakes, Fish ponds, Microclimatology, Soil temperature, Watersheds, Advection, Frozen ground, Littoral environment, Aquatic plants, Czechoslovakia, Ecosystems.

A number of microclimatic observations and soil temperature measurements carried out in Czechoslovakia, mainly around large artificial lakes used mostly as intensively managed fish ponds. Comparative measurements were made along the environmental gradients between terrestrial biotopes and shallow water-bodies, mainly in the Trebon Basin. The integrated ecological program involved long-term microclimatic observations and measurements in the Mokre Louky wetlands situated on the shore of the Rozmberk fishpond. Earlier studies were made near the Opatovicky fishpond in the same area, and further sample areas in South Bohemia, South Moravia, and even Poland, were taken into consideration. Temperature and related microclimatic factors in the central European wetlands undergo dramatic changes under the influence of seasonal climatic fluctuations, and also due to the more unpredictable effects of the hydrology of the entire catchment area. In smaller wetland biotopes, air currents and inflowing water cause marked advection processes that disturb the regular spatio-temporal pattern of temperature. Frozen soil covered by a layer of dead litter can markedly retard the start of the growing season. Horizontal gradients between the open water and adjacent terrestrial biotopes are heavily modified by the size and depth of the water body and by the arrangement of the littoral vegetation. If adequately compared, large wetlands may be found to be responsible for reduced temperature averages and increased relative humidity, in comparison with the terrestrial area. Aquatic plants affect the stratification of tem-

perature in the water column mainly by their selective scattering and absorption of the radiation, and by local reduction of turbulence under the cover of large floating leaves. (Shidler-PTT)
W89-00124

EVAPOTRANSPIRATION OF A WILLOW CARR IN SUMMER,
Ceskoslovenska Akademie Ved, Trebon. Dept. of Hydrobotany.
For primary bibliographic entry see Field 2D.
W89-00125

SEED GERMINATION TRAITS OF ANNUALS AND EMERGENTS RECRUITED DURING DRAWDOWNS IN THE DELTA MARSH, MANITOBA, CANADA,
Iowa State Univ., Ames. Dept. of Botany.
M. I. Galinato, and A. G. van der Valk.
Aquatic Botany AQBODS, Vol. 26, No. 1/2, p 89-102, November 1986. 2 fig, 2 tab, 38 ref.

Descriptors: *Wetlands, *Seeds, *Germination, *Marsh plants, *Revegetation, *Drawdown, *Marshes, Standing waters, Mud flats, Aster, Hordeum, Light quality, Temperature effects, Seedlings, Salinity, Ecological distribution, Manitoba, Canada.

Seed germination of the most abundant plants that become established during drawdowns (periods when all or part of a wetland is free of standing water) was examined. Seeds of both mudflat annuals (Aster laurentianus, Atriplex patula, and Chenopodium rubrum) and emergent perennials (Hordeum jubatum, Scolochloa festucacea, Phragmites australis, and Typha glauca) from this prairie, lacustrine marsh germinated best in the light. Stratification also improved the seed germination percentages of all species except Scolochloa. Germination percentages were highest in alternating 15/25 C and 20/30 C temperature regimes and lowest in a 5/15 C regime. Seed germination percentages for all species were highest when the seeds were on the surface and declined sharply when seeds were covered by as little as 1 cm of sand. Seedlings of species with large seeds (e.g., Hordeum and Scolochloa) could reach the surface from soil depths of down to 5 cm whereas seedlings of the smallest-seeded species (Typha) could reach the surface from no more than 1 cm depth. Seed germination of Hordeum and Phragmites was unaffected by salinities as high as 5000 mg/L of NaCl, whereas seed germination of Typha and Scolochloa was reduced significantly by 1000 mg/L of NaCl. Of the three annuals, seed germination of Aster was least affected by increasing salinity levels (no effect until 4000 mg/L) while that of Chenopodium was the most sensitive (reduced at 2000 mg/L). Because the germination of seeds of each species is affected differently by temperature, salinity, light conditions, and depth of burial, microenvironmental variations from site to site during a drawdown could result in different species becoming established at sites with identical seed banks. (Author's abstract)
W89-00126

CARBON SOURCE OF THE WATER SOLDIER, STRATIOTES ALOIDES L.,
Biologisch Centrum, Haren (Netherlands). Dept. of Plant Physiology.
H. B. A. Prins, and M. B. de Guia.
Aquatic Botany AQBODS, Vol. 26, No. 3/4, p 225-234, December 1986. 2 fig, 5 tab, 24 ref.

Descriptors: *Plant physiology, *Lentic environment, *Limiting nutrients, *Carbon, *Bicarbonates, *Aquatic plants, Stratiotes, Inorganic compounds, Carbon dioxide, Decomposing organic matter, Ecosystems, Plant growth, Photosynthesis, Netherlands.

Stratiotes aloides is one of the aquatic plants in The Netherlands which is being threatened by anthropogenic manipulation of aquatic ecosystems. S. aloides normally grows in water with a high content of dissolved inorganic carbon (DIC), moderate pH and high free carbon dioxide concentration, thus suggesting a need for a high amount of carbon to attain optimal growth. The carbon source and carbon utilization during the vegetative development of S. aloides was investigated. Measurements of the total carbon dioxide compensation concentration and leaf surface pH indicate that the plant can utilize bicarbonate for photosynthesis. The delta-13C value of the water in a Stratiotes-dominated pond was more negative than would be expected from equilibrium with air. This, and the high DIC content indicate that decaying organic material on the bottom contributes significantly to the DIC pool. The delta-13C values of the different age groups of S. aloides leaves showed a general tendency to be more negative towards the end of the vegetation season. Given the delta-13C value of the water, the discrimination by the plants is small. This indicates that diffusion is limiting photosynthesis, and/or that bicarbonate is a significant carbon source, despite the high free carbon dioxide content of the water. The results suggest that S. aloides experiences a carbon deficiency during the early submerged stage of development which is relieved when the plants come above water. (Author's abstract)
W89-00128

GROWTH STRATEGIES AND DISTRIBUTION OF ISOETIDS IN SCOTTISH FRESHWATER LOCHS,
Saint Andrews Univ. (Scotland). Dept. of Plant Biology and Ecology.
For primary bibliographic entry see Field 5C.
W89-00129

LAKE ENRICHMENT BY SUBMERSED MACROPHYTES: A NORWEGIAN WHOLE-LAKE EXPERIENCE WITH ELODEA CANADENSIS,
Norsk Inst. for Vannforskning, Oslo.
B. Rorslett, D. Berge, and S. W. Johansen.
Aquatic Botany AQBODS, Vol. 26, No. 3/4, p 325-340, December 1986. 6 fig, 4 tab, 35 ref.

Descriptors: *Enrichment, *Lakes, *Submerged plants, *Limnology, *Eutrophication, *Elodea, Mesotrophic lakes, Ecosystems, Water depth, Biomass, Phytoplankton, Macrophytes, Nutrients, Species diversity, Sediments, Norway, Aquatic productivity.

The submerged macrophyte Elodea canadensis heavily infested the mesotrophic lake Steinsfjord (SE Norway, area 13.9 sq km) in the late 1970s. This study reports an assessment of the impact of Elodea, primarily focussing on the lake's response at the ecosystem level. The species colonized 79% of the lake floor within the 0- to 6-m depth range. Averaged over the infested area, Elodea attained a peak biomass up to 310 g dry weight/sq m. The combined production of phytoplankton and macrophytes increased significantly, but we could not demonstrate major nutrient-enrichment of the lake waters, and in general pelagial primary production declined. However, some short-term dieback incidents, mainly in the summer, clearly enriched the lake waters. The impacted ecosystem rapidly stabilized after the initial perturbation. Sufficient depletion of sediment nutrients, coupled with slow in-situ regeneration of nutrients allows for effective negative feedback. Ecosystem complexity (species richness) was largely unaffected, although one aspect of complexity, i.e., evenness, in fact decreased. The observed production enhancement is due to the invader's superior utilization of space and sediment nutrient resources. (Author's abstract)
W89-00131

SCANNING ELECTRON MICROSCOPY OF BACTERIA AND DIATOMS ATTACHED TO A SUBMERGED MACROPHYTE IN AN INCREASINGLY POLLUTED STREAM,
Hohenheim Univ., Stuttgart (Germany, F.R.). Inst. fuer Bodenkunde und Standortslehre.
For primary bibliographic entry see Field 5C.
W89-00132

GREAT LAKES SHORE EROSION,
Citadel, Charleston, SC.
For primary bibliographic entry see Field 4D.
W89-00133

EFFECT OF 3,4 BENZOPYRENE ON THE PHOTOSYNTHETIC AND RESPIRATORY INTENSITY OF THE GREEN ALGA SCENEDESMUS QUADRICAUDA (DER EINFLUSS VON 3,4-BENZPYREN AUD DIE PHOTOSYNTHESE- UNE RESPIRATIONSINTENSITAT DER GRUENALGE SCENEDESMUS QUADRICAUDA),
Rostock Univ. (German D.R.). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W89-00135

OXYGEN BUDGET OF A RIVER IN SUBMERGED MACROPHYTES (RIVER ZSCHOPAU IN THE SOUTH OF THE GDR),
Technische Univ., Dresden (German D.R.). Sektion Wasserwesen.
J. Muller, and G. Weise.
Internationale Revue der Gesamten Hydrobiologie IGHYAZ, Vol. 72, No. 6, p 653-667, 1987. 8 fig, 4 tab, 22 ref.

Descriptors: *Oxygen budget, *River Zschopau, *Macrophytes, *Seasonal variation, *Oxygen, *Carbon dioxide, Germany, Rivers, Primary production, Comparison studies, Respiration, Infrared gas analysis, East Germany, Oxygen electrodes.

The oxygen budget of the river Zschopau (East Germany) was investigated with regard to seasonal variation in the activity of submerged macrophytes. The specific activities of the dominant submerged macrophyte species, Ranunculus penicillatus, were measured by analysis of their gas metabolism in the laboratory. The results permitted a comparison of data concerning the rate of CO2 metabolism obtained by infrared gas analysis and electrochemical investigations by means of oxygen and carbon dioxide electrodes. The plants were exposed to daylight temperature at 20 C and 5 C in closed reactors through which air was bubbled at a rate of 40 l/h. Differences in CO2 concentrations were measured against control air bubbled through a control reactor without macrophytes. Simultaneously, the oxygen and CO2 concentrations and the pH values were measured electrochemically by means of probes in the water containing macrophyte samples. The infrared gas analysis method is more suitable for measuring specific net assimilation and dark respiration of submerged macrophytes in their diurnal and seasonal variation. On the other hand, measuring oxygen concentrations by means of electrodes has the advantage of better simulating the full range of variation of the conditions in the river. The use of oxygen electrodes only (as opposed to CO2 and O2) is recommended. (Miller-PTT)
W89-00137

RELATIONSHIP BETWEEN ZOOPLANKTON DEVELOPMENT AND ENVIRONMENTAL CONDITIONS IN DIFFERENT TYPES OF LAKES IN THE ZONE OF TEMPERATE CLIMATE.
Akademiya Nauk SSSR, Leningrad. Zoologicheskii Inst.
M. Ivanova.
Internationale Revue der Gesamten Hydrobiologie IGHYAZ, Vol. 72, No. 6, p 669-684, 1987. 5 fig, 2 tab, 34 ref.

Descriptors: *Zooplankton, *Lakes, *Temperate zone, *Limnology, *Limiting factors, *Biomass, Benthos, Plankton, Regression analysis, Productivity, Lake classification.

Comparison of the number of species and biomass of planktonic crustaceans with morphometric, hydrochemical features of lakes in the temperate zone shows that there are no functional correlations between the development of zooplankton and each of the other separate factors. Results of multiple regression analysis for the description of relationships between biotic and abiotic conditions were unsatisfactory (R squared < or = 0.7). It is apparently necessary to find methods to examine environmental characteristics limiting biological pro-

ductivity in lakes and to classify lakes on this basis. Such classification may allow the quantitative prediction of plankton and benthos biomass development in response to the change of some environmental factors. (Author's abstract)
W89-00138

SEASONAL COMPOSITION, BIOMASS AND PRIMARY PRODUCTIVITY OF THE PHYTOPLANKTON IN LAKITELEK BACKWATER DURING 1980 AND 1983,
Lower-Tisza District Water Authority, Szeged (Hungary).
K. Kovacs.
Tiscia (Szeged), Vol. 21, p 3-12, 1986. 3 fig, 3 tab, 17 ref.

Descriptors: *Seasonal variation, *Primary productivity, *Phytoplankton, *Eutrophication, Rivers, *Tisza River, *Hungary, *Backwater, *Species composition, Algal growth, Biomass, Cluster analysis, Algae, Diatoms, Chlorophyta, Euglenophyta, Pyrrophyta, Cyanophyta.

Seasonal variation in the species composition and biomass of the phytoplankton were studied in the northern region of the backwater of the River Tisza (Hungary). Samples were collected at monthly intervals between 1980 and 1983 at three sampling stations at equal intervals. The biomass and density of the phytoplankton were measured on the basis of total algal counts. Temporal similarities in phytoplankton associations were evaluated by hierarchical cluster analysis. Primary production rates in relation to solar radiation were estimated with the oxygen light-dark bottle method. The tendencies of the algal communities to undergo compositional changes were the same throughout the backwater during the period studied. However, there were obvious differences between the species composition during periods ranging from October to March and from July to September. The winter phytoplankton was dominated by species of Chrysophyceae and Pyrrophyta, while in the late spring collections of Euglenophyta and Cyanophyceae were the most frequent. In summer, the small-bodied (< 10 micrometers) green algae (mainly Chlorococcales) were the most abundant. Diatoms (Centrales) were present in high individual numbers throughout the year. The seasonal distribution pattern of the biomass showed three distinct peaks: (1) between December and February (16-26 mg/l), (2) in May or June (6-10 mg/l), and (3) in September or October (8-39 mg/l). The primary production rates measured in 1981 show eutrophic, polytrophic and hypertrophic subregions were differentiated in the backwater at Lakitelek. (Author's abstract)
W89-00144

MICROBIOLOGICAL EXAMINATION OF THE CARSKA BARA SWAMP WATER,
Novi Sad Univ. (Yugoslavia). Inst. of Biology.
S. Gajin, O. Petrovic, M. Gantar, and M. Matavulj.
Tiscia (Szeged), Vol. 21, p 45-53, 1986. 3 fig, 10 ref.

Descriptors: *Microbiological studies, *Carska Bara Swamp, *Yugoslavia, *Wetlands, *Swamps, *Bacteria, *Heterotrophic bacteria, *Plankton, Electron microscopy, Cultivation, Seasonal variation, Coefficient, Correlation.

The microbiological examinations of the Carska bara swamp water performed from the middle of 1981 to the middle of 1984 are discussed. These included the total count of bacterioplankton by means of direct method, and the count of heterotrophic bacteria by means of cultivation methods. Electron microscopic examinations of plankton and attached forms of bacteria were done to get a more complete pattern of microbe populations. The results show significant fluctuations that are not always seasonal. Relatively low coefficients of correlation between the count of bacteria and observed physico-chemical parameters in swamp water were found. (Author's abstract)
W89-00146

SEASONAL CHANGES OF PHYTOPLANKTON IN THE BACKWATER BOKROS,
Lower-Tisza District Water Authority, Szeged (Hungary).
For primary bibliographic entry see Field 2H.
W89-00147

SEASONAL CHANGES OF PHYTOPLANKTON IN THE BACKWATER BOKROS,
Lower-Tisza District Water Authority, Szeged (Hungary).
E. Dobler.
Tiscia (Szeged), Vol. 22, p 3-12, 1987. 6 fig, 27 ref.

Descriptors: *Backwater, *Seasonal variation, *Bokros Backwater, *Algae, *Hungary, *Tisza River, *Species composition, *Phytoplankton, Population density, Species diversity, Water sampling, Population dynamics, Cyanophyta, Diatoms, Chlorophyta, DIVDROP method, Rivers, Biomass.

The seasonal changes occurring in 1984 in the phytoplankton of the backwater at Bokros based on species composition and population quantities. The result of the analysis of monthly samples was expressed in percents of the prevailing total organisms number (Cyanophyta, Diatomae, Chlorophyta and others). The seasonal changes of biomass were calculated from the volume of alga well. The theory of diversity was employed in an attempt to determine which organisms were responsible for the small values of diversity. A new method, DIVDROP, was used. Investigations were supplemented with data of relative chlorophyll contents of the phytoplankton biomass. (Author's abstract)
W89-00147

COMPARISON OF NUTRIENTS IN THE INTERSTITIAL WATER OF REDUCING (TAMAR ESTUARY) AND OXIC (CARMARTHEN BAY) COASTAL SEDIMENTS,
Institute for Marine Environmental Research, Plymouth (England).
For primary bibliographic entry see Field 2L.
W89-00156

USE OF PLANT MICRO-NUTRIENT AND CHLOROPHYLL RECORDS AS INDICES OF EUTROPHICATION IN INSHORE WATERS,
University Coll. of North Wales, Menai Bridge. Marine Science Labs.
For primary bibliographic entry see Field 5A.
W89-00160

EFFECT OF THE HYDROLOGICAL REGIME ON PRIMARY PRODUCTION IN THE MAIN STREAM AND THE SIDE ARMS OF THE RIVER DANUBE,
Laboratorium Rybarstva a Hydrobiologie, Bratislava (Czechoslovakia).
M. Ertl.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 68, No. 2, p 139-148, December 1985. 2 fig, 2 tab, 15 ref.

Descriptors: *Phytoplankton, *Primary productivity, *Rivers, *Flood plains, *Hydrological regime, Discharge frequency, Water currents, Flow duration, Ecosystems, Danube River.

The effect of the hydrological regime on the production of phytoplankton in the main channel of the Danube River and in the side arms situated in the floodplain was studied during four consecutive years. Negative correlation has been found between annual averages of discharge and primary production. In the side arms the highest production rate of phytoplankton was connected with a slow and constant current. When the arms were stagnant, a decrease of primary production was observed. (Author's abstract)
W89-00162

INTERACTION OF SOME ENVIRONMENTAL FACTORS IN THE DANUBE DELTA ON THE DELIMITATION OF THE VITAL SPACE OCCUPIED BY THE REED, MACE REED AND SEDGE CENOSES (DIE EINWIRKUNG EINIGER UMWELTFAKTOREN DES DONAUDELTAS AUF DIE ABGRENZUNG DES LEBENSRAUMES VON SCHILF-, ROHRKOLBEN- UND SEGGENGESELLSCHAFTEN),
T. Roman, L. Roman, C. Raduca, and A. Molnar.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 68, No. 2, p 149-162, December 1985. 4 fig, 1 tab, 10 fig. English summary.

Descriptors: *Deltas, *Rivers, *Aquatic plants, Reeds, Sedge, Ecosystems, Soil types, Soil water, Hydrogen ion concentration, Water depth, Water temperature, Light, Danube River.

The space occupied by the three cenoses in the reed plots in the Danube Delta is determined by the local environmental conditions, of which the type of soil, the pH of the horizons and the variation of the water layer depth on the land contour lines play a major part. The mace reed is strictly dependent upon the type of soil and the pH of the horizons (peat-humiferous and humiferous-oozy with a pH from acid to slightly acid), is dependent upon the water presence at least at the soil surface level, and is not affected by the water layer depth (up to 200 cm depth) nor by the light and temperature variations. The reed is strictly dependent upon the water layer depth (up to 100 cm), the pH of the horizons (neutral to moderately alkaline) and light and temperature variations. The sedge is strictly dependent upon the water layer depth (up to 70 cm), is dependent upon the water presence at least at the rhizome level and is not affected by of soil, the pH of horizons and the temperature variations. (Author's abstract)
W89-00163

SEASONAL FLUCTUATIONS IN THE SPECIES COMPOSITION OF PHYTOPLANKTON AND PHYTOBENTHOS IN THE LOBAU NEAR VIENNA (JAHRESZEITLICHE SCHWANKUNGEN IN DER ZUSAMMENSETZUNG DES PHYTOPLANKTONS UND PHYTOBENTHOS IN ALTWASSERN DER LOBAU BEI WIEN),
J. Schwencke-Hofmann.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 68, No. 3/4, p 269-308, May 1987. 17 fig, 4 tab, 43 ref. English summary.

Descriptors: *Limnology, *Phytoplankton, *Benthic flora, *Algae, *Lakes, Species composition, Seasonal variation, Water temperature, Aquatic plants, Danube River.

During a three year period physical and biological samples were taken from four different sites of side arms of the Danube east of Vienna, which are fed either by groundwater or by water from the Danube. The temperature regime differs from that of deeper lakes. In all seasons homothermic conditions could be observed and sometimes there was also stratification of temperature. There was a total of 541 algae species, 297 of which could be observed in the plankton. All species showed partially different distribution as well as occurrence and frequency. Algae blooms were observed for the following species: Stephanodiscus hantzchii, Synura uvella, Peridinium palatinum, Anabaena circinalis, Dinobryon divergens, Chlamydomonas sp. and Asterionella formosa. Depending on the location periphyton algae developed with great frequency on stones and waterplants. The following genera were dominant: Fragilaria, Cymbella, Rhopalodia, Navicula, Nitzchia and Diatoma. The periphyton on waterplants grew mainly on Myriophyllum and Ceratophyllum. (Author's abstract)
W89-00166

STRUCTURE OF MACROBENTHIC BIOMASS IN THE GRAVEL BED OF THE PRE-ALPINE LOISACH RIVER (DIE STRUKTUR DER MAKROBENTHISCHEN BIOMASSE IN EINEM VORALPINEN SCHOTTERBETT AM BEISPIEL DER MITTLEREN LOISACH),
Bayerische Landesanstalt fuer Wasserforschung, Munich (Germany, F.R.).
B. Wachs.
Archiv fuer Hydrobiologie, Supplement AHBSA8,

Vol. 68, No. 3/4, p 309-324, May 1987. 4 fig, 5 tab, 15 ref. English summary.

Descriptors: *Benthos, *Germany, *Rivers, *Benthic fauna, *Loisach River, *Biomass, *Alpine regions, Phosphorus, Nitrogen, Organic Matter, Dry matter.

In order to assess the zoobenthic drift in the pre-Alpine Loisach River at river-km 51.4 qualitative and quantitative determinations of benthos abundance were carried out between 1979 and 1982. These ecological investigations provided information on the area-specific presence of wet mass, dry mass and organic dry mass as well as the total phosphorous and total nitrogen copntent of benthos collected from the gravel bed which is characteristic for pre-Alpine streams. This environment is kept in nearly constant motion by bed-load transport. In the substrate of such a river bed one generally observes considerable mixing of epirheic benthos with organisms typical for the psammal. During periods of high-water many zoobenthic organisms in the gravel bed can move into the sand-pore system of the hyporheal so that a high-water wave only carries certain species into the Kochelsee which is located downstream from the sampling site. The investigations were carried out as part of a special research program of the Technical University of Munich; one goal of this program was to establish the material balance of a thoroughly flushed pre-Alpine lake (Kochelsee). (Author's abstract)
W89-00167

PHYTOPLANKTON STUDIES OF SLOWLY RUNNING WATERS: RIVERS DANUBE AND VILS (PHYTOPLANKTONSTUDIEN AN LANGAMFLIESSENDEN GEWASSERN: DONAU UND VILS),

Ministerium fuer Wirtschaft, Mittelstand und Verkehr des Landes Nordrhein-Westfalen, Duesseldorf (Germany, F.R.).
For primary bibliographic entry see Field 2E.
W89-00172

INVESTIGATIONS OF THE ECOTOXICOLOGICAL EFFECT OF AN HERBICIDE IN AN AQUATIC MODEL ECOSYSTEM: II. FOOD CHAIN SIGNIFICANCE AND PESTICIDE BALANCE (UNTERSUCHUNGEN ZUR OKOTOXIKOLOGISCHEN WIRKUNG EINES HERBIZIDS IN EINEM AQUATISCHEN MODELLOKOSYSTEM: II. NAHRUNGSKETTENPROBLEME UND SCHADSTOFFBILANZIERUNG),

Technische Univ. Berlin (Germany, F.R.). Inst. fuer Technischen Umweltschutz.
For primary bibliographic entry see Field 5C.
W89-00175

QUANTUM YIELD AS A FUNDAMENTAL PARAMETER CONTROLLING VERTICAL PHOTOSYNTHETIC PROFILES OF PHYTOPLANKTON IN LAKE CONSTANCE,

Konstanz Univ. (Germany, F.R.). Limnological Inst.
M. M. Tilzer.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 69, No. 2, p 169-198, May 1984. 7 fig, 3 tab, 54 ref.

Descriptors: *Limnology, *Lake Constance, *Quantum yield, *Phytoplankton, *Algae, *Photosynthesis, *Lakes, *Switzerland, Vertical distribution, Seasonal variation, Diurnal variation, Light intensity, Species composition, Water depth, Lakes.

Vertical shifts in quantum yields of phytoplankton photosynthesis were analyzed in meso-eutrophic Lake Constance. Both seasonal and diel variations in photosynthetic responses to light were apparent. Near the lake surface where light saturation and light inhibition occurs, quantum yields were generally low. At depths where light was limiting, maximum values were attained. However, plateaus of maximum quantum yields in deep water as postulated from theory were only observed when thermal stability was low or absent (spring, autumn). During summer, by contrast, quantum yields either increased or decreased with depth. During the course of a day, significant changes in photosynthetic light responses by algae were observed. The seasonal range of mid-day maximum quantum yields was 0.022-0.092 moles C assimilated per mole PAR absorbed. Over the course of a day, maximum quantum yields varied threefold. These results are discussed in view of existing methodological problems for estimating quantum yields as well as changes in algal light-shade adaptation and species composition. (Author's abstract)
W89-00176

DIEL AND SEASONAL CARBON BUDGETS IN TWO COLD SPRING ECOSYSTEMS,

Idaho Div. of Environment, Pocatello.
J. A. Perry, and F. L. Rose.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 69, No. 3, p 333-363, September 1984. 10 fig, 12 tab, 69 ref.

Descriptors: *Springs, *Carbon cycle, *Organic carbon, *Macrophytes, *Standing crops, Ecosystems, Rivers, Marshes, Diel variation, Seasonal variation, Primary productivity, Groundwater dynamics, Streams, Respiration, Idaho, Particulate matter.

The assumption of constancy in spring organic carbon budgets was tested. Carbon flux estimates through two stream ecosystems in Idaho are reported. The springs were studied with Fisher's stream segment model; results are expressed as g/sq m/d transport loading, and g/sq m/d net budget. No similar study on a cold spring stream has been published. Results are presented as (a) tests of hypotheses, and (b) comparisons with streams, rivers and marshes. Usually diel variation was not significantly greater than measurement precision; dissolved organic carbon was a notable exception. Annual variation was significant for nearly all variables at all stations. This implies that groundwater dynamics may affect the constancy usually attributed to spring streams. Spring streams are highly resilient due to influences of velocity; they are also more resistant than most headwater streams since they have large standing crops of readily degradable organic matter. Gross primary production (3000-5000 g C/sq m/y) and total carbon standing crop (200-1200 g C/sq m) were similar to marshes. Respiration (8000 g C/sq m/y) was higher than production; the systems were not in balance during the study year. Macrophyte stems served as retention structures and acted as a template for carbon processing. Particulate organic carbon is larger in springs (71-89 microns) than in streams and the springs were generators of large particulate organic matter; there was a 12 micron increase in median particle size through the 250 m study reach. Coarse particulate:fine particulate ratios were very small (0.025 to 0.001); spring inputs to headwater streams will accelerate proposed reductions in ratios along a river course. Macrophyte standing crops and detrital standing crops varied significantly with season. Living biomass was reduced in fall; detrital biomass was almost totally processed and/or flushed over winter. (Author's abstract)
W89-00177

ATTEMPT TO ESTIMATE THE FISH STOCK AND THE SUSTAINABLE YIELD OF LAKE ZIWAY AND LAKE ABAYA, ETHIOPIAN RIFT VALLEY,

R. Schroeder.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 69, No. 3, September 1984. 12 fig, 6 tab, 19 ref.

Descriptors: *Lake Ziway, *Lake Abaya, *Lake fisheries, *Fish stocking, *Fish populations, *Primary productivity, Climatic data, Conductivity, Seasonal variation, Water temperature, Cycling nutrients, Rift Valley, Ethiopia, Tropical regions, Limnology, Nile River, Social values.

Lake Ziway and Lake Abaya, similar in morphometric and chemical properties, have in common a reduced productivity of fish biomass, but for different reasons. In Lake Ziway, there is a coincidence of spawning activity in the littoral zone and the custom of people to consume for religious reasons ten times as much fish at this period than in the rest of the year. This coincidence meets the one-species fish stock in its most sensitive period because the eggs and fry are carelessly destroyed. In Lake Abaya, primary productivity is restricted to the littoral zone where it is supported by allochthonous organic matter. After the origin of the Great Rift Valley, a number of lakes were created in Ethiopia where fish species of the River Nile system are living. The shallow lakes are polymictic, with a complete turnover mixing due to even slight wind action. This is generally in October-November, and also in January-February, when more or less constant and even strong winds can occur. In the calmer season a stratification can be built up, but the temperature difference between surface and bottom is usually not more than 2 C. The lakes are in a pristine condition because their watersheds and shores are sparsely populated and agriculture does not yet use fertilizers intensively. Due to the constant climatic conditions the productivity continues uninterrupted at the same level and is maintained by frequent mixing of the whole water body. Nutrients are permanently incorporated and again liberated by vertical movements which keep the particle sin circulation. The water of most of the lakes is turbid and contains brown greenish bottom material. The only climatic variations are the rainy and dry periods. The main rainy season, between mid-June and mid-September, causes a rise in water level and flooding of the shores. The water temperature, between 23-25 C , drops by 2 C. The dry season, from October to February, decreases the water level. The participation in a project for the exploitation of the fish resources of two of these lakes provided the possibility to receive more information about limnic systems on which little scientific work has been done. (Authors abstract)
W89-00178

EFFECTS OF ACIDIFICATION AND PHOSPHORUS ADDITION ON PHYTOPLANKTON BIOMASS AND PRODUCTIVITY IN A CIRCUM-NEUTRAL MESOTROPHIC LAKE RECEIVING ACID PRECIPITATION,

West Virginia Univ., Morgantown.
K. E. Havens, and J. DeCosta.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 69, No. 4, p 443-476, October 1984. 11 fig, 19 tab, 30 ref.

Descriptors: *Acid rain, *Precipitation, *Mesotrophic lakes, *Phosphorus, *Phytoplankton, *Primary productivity, *Eutrophication, Biomass, Trophic level, Hydrogen ion concentration, Nutrients, Lake O'Woods, West Virginia, Limestone, Buffering, Limnology, Acidic water, Algae.

A one year study was performed in 1980 to determine the trophic status of Lake O'Woods, and assess the impact of acid precipitation on this shallow lake. In situ bag experiments were performed during 1980 and 1981 to examine the effects of acidification and phosphorus addition on algal biomass and productivity. Lake O'Woods is mesotrophic based on several classification criteria, and despite extensive inputs of acid precipitation, maintains a circumneutral pH. A large limestone formation in the watershed will provide a long term source of buffering. In the bag experiments, P addition resulted in rapid algal growth, even when coupled with extreme acidification, and N became secondarily limiting in these treatments during 2 of the 3 experiments. Phytoplankton biomass, productivity, and assimilation efficiency were not significantly reduced by acidification, except for an initial period of 'pH shock' immediately following acidification. The results conform those of earlier comparative studies, and demonstrate that upon acidification, phytoplankton biomass and productivity in a lake are determined by nutrient availability, and are not reduced by acidification per se. (Author's abstract)
W89-00179

MODEL ECOSYSTEMS AS A TOOL IN FRESHWATER AND MARINE RESEARCH,

National Swedish Environment Protection Board.

Solna.
For primary bibliographic entry see Field 5B.
W89-00180

COMMUNITY GRAZING AND THE REGULATION OF IN SITU CLEARANCE AND FEEDING RATES OF PLANKTONIC CRUSTACEANS IN LAKES IN THE KUOKKEL AREA, NORTHERN SWEDEN,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
G. Persson.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 70, No. 2, p 197-238, April 1985. 6 fig, 8 tab, 92 ref.

Descriptors: *Zooplankton, *Crustaceans, *Oligotrophic lakes, *Feeding, *Limnology, *Eutrophication, *Nutrients, Seston, Algae, Bacteria, Primary productivity, Fertilization, Chlamydomonas, Isotopic tracers, Sweden, Deficient elements, Mortality.

In situ grazing by 5 crustacean zooplankton species was assessed in two originally oligotrophic lakes, one of which had been fertilized. Animals were fed dual-labelled lake seston (tritiated acetate and carbon-14 CO2) and in addition a labelled tracer cell (Chlamydomonas). Clearance rate data from both lakes were used to construct a simple feeding rate model considering temperature, animal length and abundance, and biomass of algae and bacteria in 8 size groups. Model applications gave mean seasonal community clearance of 0.08-0.23/day in the 2 lakes from which it was derived and an additional fertilized lake. This is in the medium range of cited references (including eutrophic lakes). Mean seasonal community grazing rates were 22-85% of primary productivity rates. It was hypothesized that in oligotrophic lakes physiological mortality due to nutrient deficiency is the main source of losses for phytoplankton. In the fertilized lakes the modeled grazing rates were high and incongruent with other indicators of grazing pressure. (Author's abstract)
W89-00181

POPULATION DYNAMICS AND PRODUCTION OF CHIRONOMIDAE (DIPTERA) AT 2 M DEPTH IN LAKE ESROM, DENMARK,
Marine Research Inst., Reykjavik (Iceland).
E. Jonsson.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 70, No. 2, p 239-278, April 1985. 17 fig, 6 tab, 60 ref.

Descriptors: *Lake Esrom, *Midges, *Denmark, *Benthic fauna, *Eutrophic lakes, *Population dynamics, *Life cycles, Chironomidae, Diptera, Species composition, Oxygen, Denmark, Aquatic insects, Seasonal variation, Growth, Limnology, Oxygen deficint, Secondary productivity.

Chironomidae were sampled between May 1979 and June 1980 at 2 m depth in eutrophic Lake Esrom, Denmark. Twenty-five chironomid taxa, averaging 36,000 individuals/sq m, were found. These accounted for 34% of the total macrobenthic fauna. The dominating species contained hemoglobin, reflecting the oxygen undersaturation at the sampling site. The life cycles of 11 species were described, these being represented with four different types. Stictochironomus histrio and Psilotanypus sp. showed one generation per year. Procladius spp. and Cryptochironomus sp. also showed one generation per year with flight periods in early summer, but the largest individuals in the population emerged in autumn, while most of the population overwintered. The dominating life cycle type occurred with Dicrotendipes pulsus, Microtendipes sp., Polypedilum nubeculosum, Endochironomus albipennis and Tanytarsus spp., each showing 2 generations per year. Cladotanytarsus spp. and T. brundini had 3 generations per year. Migration of Tanytarsini larvae to the sampling site was found during the winter and early spring. Total chironomid production, after compensation for weight loss due to preservation, was estimated to be between 17-18.5 g ash free dry weight/sq m/yr, or about 96-104 kcal/sq m/yr. Cladotanytarsus spp. were the most important producer accounting for 30% of the total annual production. Dicrotendipes pulsus accounted for 21%, Tanytarsus spp. for 14% and Microtendipes sp. for 11% of the annual production of the chironomid community. Annual production was bimodal. The P/B ratio of the chironomid species was dependent on voltinism and growth pattern. (Author's abstract)
W89-00182

NEW ASPECTS OF THE SULFUR CYCLE, WITH SPECIAL REFERENCE TO SHALLOW WATERS,
Hajdu-Bihar County Water Canalization Works, Debrecen (Hungary).
For primary bibliographic entry see Field 5B.
W89-00183

BENTHIC CYANOPHYTE ASSOCIATIONS IN STREAMS AND LAKES (BENTHISCHE CYANOPHYTEN-GEMEINSCHAFTEN IN BACHEN UND SEEN),
Oesterreichische Akademie der Wissenschaften, Vienna. Biologische Station.
E. Kann.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 71, No. 1/2, p 307-310, August 1985. 6 ref. English summary.

Descriptors: *Limnology, *Cyanophyta, *Lakes, *Streams, *Benthic flora, Water level, Light, Temperature, Seasonal variation, Water currents, Water pollution, Substrates.

The development and structure of benthic communities of cyanophytes in streams and lakes are depends on many important factors. The influence of chemistry, water level, light, temperature, seasonal periodicity, current, pollution and substrate is discussed and documented by selected examples. (Author's abstract)
W89-00184

PHYSIOLOGICAL ECOLOGY OF BLUE-GREEN ALGAL MATS (MODERN STROMATOLITES) IN ANTARCTIC OASIS LAKES,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
B. C. Parker, and R. A. Wharton.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 71, No. 1/2, p 331-348, August 1985. 3 fig, 6 tab, 35 ref.

Descriptors: *Cyanophyta, *Algal mats, *Antarctic, *Lakes, *Limnology, Stromatolites, Photosynthesis, Nitrogen fixation, Calcite, Species composition, Mountain lakes, Sedimentation, Physiological ecology.

Freshwater and marine bluegreen algal mats are widespread globally and vary in their species composition, rates of photosynthesis and nitrogen fixation, all in response to their environment. In contrast, modern stromatolitic algal mats are quite rare. The latter are restricted to environmental extremes that preclude mat-burrowing or -grazing animals and inhibit microbial decomposition. The only well-documented high latitude habitats of modern stromatolitic algal mats are the freshwater depths of 7 perennially ice-covered lakes of southern Victoria Land, Antarctica. Within these unusual lakes, 5 basic macromorphological types of mats occur and 4 are stromatolitic (3 aerobic or oxygenic and one anaerobic or anoxygenic). Variables which control the mat growth rates and forms particularly include photosynthetically available radiation (PhAR), oxygen production and accumulation, calcite formation, and growth or gliding patterns of the predominant algal or microbial species. Estimated production rates of the 5 different mat types based on assumed annual PhAR, measured percent PhAR reaching various depths, and estimates of quantum efficiency show a range of more than 3 orders of magnitude and at least partially explain the occurrence and distribution of these algal mats within these lakes. (Author's abstract)
W89-00185

BIOCHEMICAL MODELS FOR THE HYPOLIMNETIC OXYGEN DEPLETION IN LAKES IMPACTED BY WASTEWATER DISCHARGES: I. ALTERNATIVE MODELS,
McMaster Univ., Hamilton (Ontario). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5C.
W89-00186

FACTORS AFFECTING NUTRIENT DYNAMICS IN A PIEDMONT NORTH CAROLINA RESERVOIR,
Duke Power Environmental Labs., Huntersville, NC.
M. S. Rodriguez.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 72, No. 1, p 110-134, September 1985.

Descriptors: *Limnology, *Mesotrophic lakes, *Reservoirs, *Nutrients, *Primary productivity, *Phytoplankton, *Cycling nutrients, Carbon, Nitrogen, Phosphorus, Phosphates, Clays, Ammonia, Nitrates, Nitrites, Nitrification, Denitrification, Ammonification, Photosynthesis, Respiration, Carbon dioxide, Hypolimnion, Epilimnion, Lake Norman, North Carolina.

Internal nutrient dynamics and primary production were studied weekly over a 1-yr period on Lake Norman, a 130 sq km, warm-monomictic, mesotrophic reservoir located in North Carolina. Carbon fluxes were governed primarily by photosynthesis and respiration. During the stratified period, phytoplankton incorporated an average of 44 nmole C/sq m/d into organic matter. Approximately 83% of this organic matter was remineralized within the epilimnion, while 17% was lost by sedimentation to the hypolimnion and sediments. During the isothermal period, and in the hypolimnion, respiration resulted in the accumulation of CO2. Turnover times for CO2 ranged from 7 d at maximum light and temperature to 324 d at minimum light and temperature. Nitrogen cycling was also primarily biochemically controlled. Photosynthesis during the summer resulted in a decline of epilimnetic concentrations of nitrate plus nitrite, in rapid ammonia turnover times (<35 h), and in a loss of total N from the water column due to the conversion of dissolved N to particulate N. N cycling during the isothermal period and in the hypolimnion was controlled primarily by ammonification, nitrification, denitrification and the physical adsorption of ammonia to sediments. Turnover times for dissolved inorganic N ranged from 9 d at maximum light and temperature to 1200 d at minimum light and temperature. Phosphorus dynamics in the epilimnion were dominated by biotic cycling, as evidenced by very high particulate carbon-to-phosphorus ratios, indicating a severe P deficiency in the phytoplankton. In contrast, P dynamics during the isothermal period and in the hypolimnion were strongly influenced by the adsorption of P to inorganic materials such as clays. The lack of accumulation of dissolved phosphate in the anoxic hypolimnion was attributed to the adsorption by clays of any remineralized phosphate. (Author's abstract)
W89-00187

DYNAMICS OF IRON AND MANGANESE IN THE SURFACE SEDIMENTS OF A SEASONALLY ANOXIC LAKE,
J. Hamilton-Taylor, and E. B. Morris.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 72, No. 2, p 135-165, September 1985.

Descriptors: *Limnology, *Lakes, *Metals, *Iron, *Manganese, *Sediments, *Lake sediments, Seasonal variation, Hypolimnion, Diatoms, Esthwaite Water, U.K.

Sixty-five cores were sampled at sites in Esthwaite Water (UK) from September 1979-July 1982. The sediments were sub-sampled under nitrogen at 1 cm intervals through the top 5 or 10 cm and then analyzed for total dissolved (<0.4 micron) and 0.5 M HCl labile Fe and Mn. The distributions of dissolved and labile Fe and Mn exhibit significant and consistent local, areal and seasonal variations. There is a general fractionation of Fe and Mn from deep-water to shallow-water sediments, the process occurring to a greater extent in the case of Mn.

Hypolimnetic sediments normally exhibit high Mn remobilization rates throughout the year in spite of a well-mixed, oxygen saturated water column in winter. The associated loss of Mn is sometimes sufficiently great for Mn oxyhydroxide availability to become a critical limiting factor in determining dissolved Mn in the sediments. This is particularly evident in late summer, at the height of anoxicity in the lake, when the unusual situation occurs of Mn diffusing into the sediments. In comparison, Fe shows a more marked and straightforward seasonal pattern of behavior in the hypolimnetic sediments. A low level of remobilization occurs during the winter period, initiated by autumnal overturn of the water column, while a period of greatly enhanced remobilization is initiated by deposition of the spring diatom bloom. Diffusion of Fe invariably occurs from the sediments into the water column. Remobilization in the hypolimnetic sediments occurs at or sufficiently close to the sediment surface that concentration profiles of dissolved Fe and Mn are either constant with depth or downward decreasing. Fe and Mn are largely retained in the shallow-water sediments due to lesser rates of remobilization, which probably occurs mainly in sub-surface sediments. Overall budget considerations generally support previously published views although our shallow-water sediment data suggest that a somewhat greater proportion (9-26%) of the Mn loading to the lake is retained in the sediments compared to the previous estimate of $<10\%$. (Author's abstract)
W89-00188

BIOCHEMICAL MODELS FOR THE HYPOLIMNETIC OXYGEN DEPLETION IN LAKES IMPACTED BY WASTEWATER DISCHARGES: 2. PHYTOPLANKTON BIOMASS MODEL,
McMaster Univ., Hamilton (Ontario). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5C.
W89-00189

DIATOMS AND OTHER ALGAE FROM THE THERMAL-SULPHUR SPRINGS OF TRIPONZO (CENTRAL ITALY),
Camerino Univ. (Italy). Inst. di Botanica.
A. Dell'Uomo.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 73, No. 1, p 79-91, April 1986. 1 fig, 2 tab, 35 ref.

Descriptors: *Thermal springs, *Sulfur springs, *Diatoms, *Algae, *Cyanophyta, *Chlorophyta, Oscillatoria, Chara, Species composition, Oxygen, Nitrates, Phosphates, Water temperature, Salinity, Triponza Springs, Italy.

In the thermal-sulphur springs of Triponzo, Oscillatoria okenii (Cyanophyceae), Chara vulgaris (Charophyceae) and 44 Bacillariophyceae of specific or infraspecific rank were found. As far as the water temperature (28 C) is concerned, these springs can be considered as 'hyalothermal'. Taking into account the biological community, and especially the well developed felts of the thermophilic blue-green alga O. okenii, they can also be arranged in the 'Oscillatoria-type' of thermal springs. There are also diatoms, all eurytherms, which allow these springs to be characterized in terms of other water properties. In particular, a group of halophilic diatoms was identified which represents, with Oscillatoria okenii, the specific characteristic combination of this thermal, inland water environment, with high salinity. There are several factors which limit, in the Triponzo springs, the development of a richer diatom community, in both a qualitative and quantitative sense. The principal ones are lack of oxygen and absence of nitrates and phosphates. (Author's abstract)
W89-00190

SEM-ANALYSIS OF COLONIES OF THE CYANOPHYTE NODULARIA WATER BLOOM FROM BALTIC SEA,
Brno Univ. (Czechoslovakia). Dept. of Biology.
J. Smarda, J. Komarek, and H. Hubel.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 73, No. 3, p 319-330, December 1986. 40 fig, 18 ref.

Descriptors: *Cyanophyta, *Plant morphology, Electron microscopy, Scanning electron microscopy, Bacteria, Actinomyces, Ecology, Succession, Baltic Sea.

The microcolony structure of the cyanophytes Nodularia spumigena and N. sp. forming blooms in the Baltic Sea, was studied by scanning electron microscopy. The morphology of the dominant Nodularia filaments is described. Their colonies represent a characteristic micro-niche which is colonized mainly by cyanophytes, bacteria and Actinomycetes-like organisms in a particular succession process which is suppressed in culture. Cultured filaments of non-axenic strains are covered only with bacteria (Seliberia). (Author's abstract)
W89-00193

PERIPHYTON DIATOM COMMUNITIES AND TROPHIC STATES OF THREE SHALLOW LAKES IN THE PFYNWALD REGION OF CANTON VALAIS, SWITZERLAND,
Zurich Univ., Kilchberg (Swizerland). Hydrobiological-Limnological Station.
J. Hurlimann, and F. Schanz.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 78, No. 3, p 351-371, April 1988. 5 fig, 4 tab, 25 ref.

Descriptors: *Lakes, *Diatoms, *Trophic level, *Limnology, *Switzerland, Species composition, Biomass, Seasonal variation.

The species composition and total biomass of the diatom populations of three lakes in the Pfynwald region varied significantly in the course of a year. Each of the lakes was characterized by its own annual succession of dominant species. This is a result of the differing physical and chemical properties of the lakes. The determination of the trophic state of each lake using the method of Lange-Bertalot, a method which was developed in order to obtain information on the saprobity levels of rivers, agreed to a large extent with the results of other chemical and biological investigations. (Author's abstract)
W89-00195

CHANGES IN PHYTOPLANKTON OVER A TEN-YEAR PERIOD IN A LAKE UNDERGOING DE-EUTROPHICATION DUE TO SURROUNDING PEAT BOGS,
Akademia Rolnicza, Lublin (Poland). Inst. of Natural Foundations of Plant Production.
I. Wojciechowski, W. Wojciechowska, K. Czernas, J. Galek, and K. Religa.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 78, No. 3, p 373-387, April 1988. 5 fig, 1 tab, 26 ref. Polish Academy of Sciencs Grant 09.1.7.

Descriptors: *Dystrophic lakes, *Eutrophic lakes, *Phytoplankton, *Algae, *Peat bogs, Chlorophyll a, Primary productivity, Fertility, Humic acids, Species composition, Biomass, Water transparency, Eutrophication, Water pollution sources.

During summer seasons the composition and biomass of phytoplankton, percent of nannoplankton, concentration of chlorophyll-a, primary production and water visibility of a the polymictic, pond-like Lake Bikeze in mid-eastern Poland were examined. The changes of the investigated parameters have shown that the lake lost an excessive degree of its fertility, which was caused by stopping major inflow by surrounding ditches not only into the lake itself, but also into the adjacent peat bogs; peat bogs have assumed an ombrophilous character and supply the lake more abundantly with humic substances. (Author's abstract)
W89-00196

ZOOPLANKTON POPULATION OF MAN-MADE LAKES IN ABRUZZI'S APPENNINES: CAMPOTOSTO LAKE (POPOLAMENTO ZOOPLANCTONICO DI UN LAGO DI SBARRAMENTO DELL'APPENNINO ABRUZZESE: IL LAGO DI CAMPOTOSTO),
Universita degli Studi 'La Sapienza', Rome (Italy). Dipt. di Biologia Animale e dell 'Uomo.
O. Ferrara.
Revista di Idrobiologia RIIDBN, Vol. 25, No. 1-3, p 19-26, 1986. 1 fig, 1 tab, 9 ref. English summary.

Descriptors: *Artificial lakes, *Zooplankton, *Rotifers, *Crustaceans, *Lake Campotosto, *Mountain lakes, *Copepods, *Cladocerans, *Waterfleas, Species composition, Population density, Reservoirs, Italy.

The zooplankton population of man-made Lake Campotosto (Central Italy) was examined from July 1983-October 1984. Vertical samples were taken at 3 stations from 5, 10, and 15 m depth. The zooplankton community is poor in species compared to other artificial lakes. A total of 18 species were identified: 12 rotifers, 2 copepods, and 4 cladocerans; 8 of these are new for the lake. Keratella cochlearis numerically dominated the Rotatoria population throughout the study period. Cyclops abyssorum was the dominant species of copepod. Cladocerans assumed an intermediate position between the other 2 groups in terms of density. The species found in the plankton show a wide ecological valence and are frequently collected in lakes of Central Italy. No detectable differences in species distribution among stations were observed. (Author's abstract)
W89-00197

PRIMARY STUDIES ON POPULATION DYNAMICS OF 3 SPECIES OF CLADOCERA (WATERFLEA) IN DIANSHAN LAKE, (IN CHINESE),
East China Normal Univ., Shanghai.
L. Wei, L. Hangang, and D. Nanshan.
Oceanologia et Limnologia Sinica, Vol. 19, No. 2, p 101-108, March 1988. 3 fig, 6 tab, 10 ref. English summary.

Descriptors: *Lakes, *Crustaceans, *Limnology, *Waterfleas, *Cladocera, *Dianshan Lake, *Population dynamics, Seasonal dynamics, Water temperature, China, Reproduction, Chlorella, Seasonal variation.

Of the 31 species of Cladocera in Dianshan Lake, 8 are superior ones in the Cladocera community. Daphnia (Daphnia) hyalina, Bosmina fatalis and Diaphanosoma brachyurum dominate the seasonal dynamics. Simulation experiments were carried out in 2 groups: one at the temperatures of 12 C, 20 C, and 25 C with Chlorella pyrenoidosa (300,000 cells/ml) as food, another one at 20 C with algae (75, 150, and 300,000 cells/ml) as food. High food concentration increases the number of eggs per brood chamber without effecting other biological parameters. Higher temperature decreases all of the biological parameters. The temperature of 12 C increases the number of eggs of Daphnia hyalina 2.5 times that of 25 C. The experiment of simulation of temperature and analysis of percentage of samples of Daphnia hyalina indicate that the animals adapt better to low temperature. The 2 peaks of seasonal dynamics are exhibited by 3 species of Cladocera. (Author's abstract)
W89-00198

CHARACTERISTICS OF DISTRIBUTION AND MIGRATION OF PHOSPHORUS IN DEPOSITS OF DIANCHI LAKE, (IN CHINESE),
Academia Sinica, Nanjing (China). Inst. of Geography.
For primary bibliographic entry see Field 5B.
W89-00200

EFFECTS OF ACIDIFICATION ON METAL BUDGETS OF LAKES AND CATCHMENTS,
Ontario Ministry of the Environment, Dorchester. Dorset Research Center.
For primary bibliographic entry see Field 5C.
W89-00207

CYCLING OF INORGANIC AND ORGANIC SULFUR IN PEAT FROM BIG RUN BOG, WEST VIRGINIA,
Villanova Univ., PA. Dept. of Biology.
R. K. Wieder, and G. E. Lang.
Biogeochemistry, Vol. 5, No. 2, p 221-242, 1988. 8

fig, 1 tab, 52 ref. National Science Foundation Grants BSR-8215731 and BSR-8516700.

Descriptors: *Acidic water, *Fate of pollutants, *Sulfur cycle, *Peat bogs, *Sulfates, Sulfides, Interstitial water, Geochemistry, Organic compounds, Inorganic compounds, Big Run Bog, West Virginia.

Total S concentration in the top 35 cm of Big Run Bog peat averaged 9.7 micromol/g wet mass (123 micromol /g dry mass). Of that total, an average of 80.8% was carbon bonded S, 10.4% was ester sulfate S, 4.5% was FS2-S, 2.7% was FeS-S, 1.2% was elemental S, and 0.4% was SO4-S. In peat collected in March 1986, injected with sulfur-34 SO4 and incubated at 4 C, mean rates of dissimilatory sulfate reduction (formation of H2S + S + FeS + FeS2), carbon bonded S formation, and ester sulfate S formation averaged 3.22, 0.53, and 0.36 nmol/g wet mass/h, respectively. Although dissolved SO4 concentrations in Big Run Bog interstitial water (<200 micromolar) are low enough to theoretically limit sulfate reducing bacteria, rates of sulfate reduction integrated throughout the top 30-35 cm of peat of 9 and 34 mmol/sq m/d (at 4 C) are greater than or comparable to rates in coastal marine sediments. It is suggested that sulfate reduction was supported by a rapid turnover of the dissolved SO4 pool (average turnover time of 1.1 days). Although > 90% of the total S was organic S, cycling of S was dominated by fluxes through the inorganic S pools. (Author's abstract)
W89-00208

NUTRIENT LEVELS AND THE DEVELOPMENT OF DIATOM AND BLUE-GREEN BLOOMS IN A SHALLOW AUSTRALIAN ESTUARY,
Western Australia Univ., Nedlands. Dept. of Botany.
R. J. Lukatelich, and A. J. McComb.
Journal of Plankton Research JPLRD9, Vol. 8, No. 4, p 597-618, July 1986. 9 fig, 3 tab, 46 ref.

Descriptors: *Salinity, *Eutrophication, *Estuaries, *Diatoms, *Cycling nutrients, Seasonal variation, Limiting nutrients, Biomass, Rivers, Australia, Time series analysis, Phosphorus, Peel-Harvey Estuary, River flow, Cyanophyta.

In the Peel-Harvey estuary system, Western Australia, some 90% of riverflow and nutrient loading occurs in three winter months. Diatom blooms follow riverflow, but are replaced by blooms of the blue-green Nodularia spumigena Mert., especially in Harvey Estuary. By analysis of time series data from 1977-1983, it is shown that the magnitude of the Nodularia bloom in summer is related to the minimum salinity of the estuary (and hence total river flow), maximum phosphate concentration and total riverine phosphorus loading, in the previous winter. The relationships have a predictive capacity. It is argued that diatom blooms trap phosphorus, which is sedimented largely as fecal pellets; the phosphorus is recycled and supports Nodularia growth under warmer conditions, and the amount available determines Nodularia biomass. Nodularia blooms collapse when summer salinities reach 30 ppt. (Author's abstract)
W89-00211

EFFECT OF LIGHT REGIME UPON GROWTH RATE AND CHEMICAL COMPOSITION OF A CLONE OF SKELETONEMA COSTATUM FROM THE TRONDHEIMSFJORD, NORWAY,
Trondheim Univ. (Norway). Biological Station.
For primary bibliographic entry see Field 2L.
W89-00212

MEASUREMENT OF PRIMARY PRODUCTIVITY IN A HIGH-RATE OXIDATION POND (HROP),
Bar-Ilan Univ., Ramat-Gan (Israel). Dept. of Life Sciences.
T. Berner, Z. Dubinsky, F. Schanz, J. U. Grobbelaar, and H. Rai.
Journal of Plankton Research JPLRD9, Vol. 8, No. 4, p 659-672, July 1986. 4 fig, 2 tab, 61 ref.

Descriptors: *Hypertropic lakes, *Algae, *Oxidation ponds, *Isotope studies, *Primary productivity, *Limnology, *Photosynthesis, Field tests, Model studies, Phytoplankton, Aquatic habitats, Comparison studies, Simulation, Nanoplankton, Computer models, Oxygen electrodes, Ponds.

A high-rate oxidation pond is studied as a model system for comparing 14C and oxygen evolution methods as tools for measuring primary productivity in hypertrophic aquatic systems. The results indicate that at very dense algal populations (up to 5 mg chlorophyll a/L) and high photosynthetic rates, 14C based results may severely underestimate primary productivity, unless a way is found to keep incubation times very short. Results obtained with an oxygen electrode were almost an order of magnitude higher than those obtained by all 14C procedures. These higher values correspond fairly well with a field-tested computer-simulation model, as well as with direct harvest data obtained at the same pond when operated under similar conditions. The examination of the size-fractionation of the photosynthetic activity underscored the important contribution of nanoplanktonic algae to the total production of the system. (Author's abstract)
W89-00213

SHORT-TERM DYNAMICS OF A MELOSIRA POPULATION IN THE PLANKTON OF AN IMPOUNDMENT IN CENTRAL CHILE,
Freshwater Biological Association, Windermere (England).
C. S. Reynolds, V. Montecino, M. E. Graf, and S. Cabrera.
Journal of Plankton Research JPLRD9, Vol. 8, No. 4, p 715-740, July 1986. 12 fig, 4 tab, 51 ref. UNESCO MAB-5 and Grant 1577/8543.

Descriptors: *Reservoirs, *Melosira, *Population dynamics, *Limnology, *Photosynthesis, *Phytoplankton, Seasonal variation, Rapel Reservoir, Shading, Diatoms, Vertical distribution, Biomass.

Relationships among the chlorophyll-specific photosynthetic behavior of a Melosira-dominated phytoplankton, net variations in the quantity of Melosira in suspension, the rates of sinking loss of Melosira cells and diel fluctuations in water-column stability were investigated in Embalse Rapel, central Chile. The short study was carried out during the autumnal equinoxial period (March, 1984) of maximal Melosira abundance to determine the extent to which these various components might contribute to the distinctly bimodal seasonal distribution of phytoplankton abundance in this reservoir. Diurnal photosynthetic production within the illuminated layer and supposed column respiration were found of a similar order, suggesting that net increase through cellular growth was already substantially limited by self-shading. Thus observed net changes in the standing population may have depended more on the relative magnitude of sinking loss rates and recruitment through resuspension, which processes are profoundly influenced by alternations in wind-induced mixing and intense, near-surface, thermal stratification. As the relative frequency and duration of these episodes vary during the year, so does the capacity of the Melosira to maintain or increase its standing biomass. High cellular photosynthetic efficiency coupled with rapid sinking rate appear to be of selective advantage when the cycle of alternation is approximately diel. The application of these findings to the seasonal distribution of M. granulata in the Rapel reservoir and to the ecology of planktonic Melosira populations elsewhere is briefly discussed. (Author's abstract)
W89-00214

RECURRENCE OF DAPHNIA ROSEA IN LAKE TAHOE: ANALYSIS OF A POPULATION PULSE,
California Univ., Davis. Inst. of Ecology.
E. R. Bryon, P. E. Sawyer, and C. R. Goldman.
Journal of Plankton Research JPLRD9, Vol. 8, No. 4, p 771-783, July 1986. 9 fig, 35 ref. NSF Grant BSR83-04916.

Descriptors: *Shrimp, *Lake Tahoe, *Daphnia, *Population dynamics, *Species composition, *Primary productivity, *Biomass, *Reproduction, *Food habits, Aquatic habitats, Aquatic animals, Crustaceans, Predation, Lakes.

Following the disappearance of all Lake Tahoe cladocera in 1970, Daphnia rosea reappeared in the lake during the summer and fall of 1983. Since the introduction and population increase of the omnivorous opossum shrimp, Mysis relicta, was heavily implicated in the initial disappearance, the D. rosea recurrence with respect to fluctuating M. relicta abundance and steadily increasing primary productivity was studied. An analysis of D. rosea population dynamics, fecundity, feeding characteristics and M. relicta feeding selectivity, suggested that D. rosea was able to coexist with M. relicta in 1983 only because D. rosea birth rates were substantially higher than historical levels due to the increase in algal productivity since 1970. The variation of cladoceran success in lakes M. relicta introductions may be due, in large part, to variations in primary productivity. (Author's abstract)
W89-00216

LOSS PROCESSES INFLUENCING GROWTH OF PLANKTONIC BACTERIAL POPULATIONS IN LAKE CONSTANCE,
Staatliches Inst. fuer Seenforschung und Fischereiwesen, Langenargen (Germany, F.R.).
H. Gude.
Journal of Plankton Research JPLRD9, Vol. 8, No. 4, p 795-810, July 1986. 5 fig, 3 tab, 44 ref.

Descriptors: *Lake Constance, *Aquatic bacteria, *Food habits, *Food chains, *Limnology, Primary productivity, *Population dynamics, Microorganisms, Phytoplankton, Zooplankton, Lakes, Isotope studies, Flagellates, Radioactive tracers, Switzerland.

The fate of bacterial production in a deep mesotrophic lake has been investigated on the basis of a multiple approach combining field and experimental studies. Bacterial production gains as estimated by measurements of methyl-(3H)thymidine incorporation into macromolecules appeared to be more or less balanced by corresponding grazing losses. This was suggested by considering abundance and grazing potential of presumed grazers as well as by following in time the binding of labelled bacteria by larger sized organisms. Strong increases in bacterial net growth were always observed after removal of grazers from the water samples. As was indicated by independent approaches, phagotrophic microflagellates were mainly responsible for the observed grazing losses. Support for the importance of alternative loss processes such as sinking or autolysis was given neither by field observations nor by long-term experiments with exclusion of grazers. It is concluded that phagotrophic microflagellates may be regarded as important functional components of planktonic communities in freshwater lakes. (Author's abstract)
W89-00217

BODY SIZE AND MASS FLOW IN FRESHWATER PLANKTON: MODELS AND TESTS,
McGill Univ., Montreal (Quebec). Dept. of Biology.
A. F. Vezina.
Journal of Plankton Research JPLRD9, Vol. 8, No. 5 p 939-956, September 1986. 8 fig, 6 tab, 81 ref.

Descriptors: *Turnover, *Model studies, *Isotope studies, *Limnology, *Body size, *Trophic dynamics, *Phytoplankton, *Zooplankton, *Predaction, *Microorganisms, *Trophic level, Food habits, Food chains, Population dynamics, Oligotrophic lakes, Lakes, Radioactive tracers.

Observations of radiotracer (32P) flow in size-fractionated lake plankton were compared with the predictions of size-dependent models of material flow. The models assume that the metabolic activity and turnover of the size fractions can be described as power functions of size. One model, called size-structured, is an application of the Platt and Denman formalism: it assumes that materials are incorporated preferentially by the smallest or-

ganisms and flow continuously toward the larger organisms. In this model, the trophodynamic flow from a size fraction is constrained to the next larger fraction. The tracer data indicated that metabolic activity could indeed be described as a continuous function of size, at least within the microplankton, but it did not support the hypothesis of a size-hierarchical trophodynamic flow. Another model limited the size range of predators to the larger, size fractions while relaxing the size dependence constraint on the trophodynamic flow. This 'unstructured' model agreed better with the 32P dynamics and generated estimates of seston P uptake and of the rates of biomass turnover that compared favorably with published estimates for oligotrophic lakes. Some problems with the fit to the data remain but might be dealt with by distinguishing a priori among functional types of planktonic organisms through fluorescence (flow cytometry) or metabolic properties (inhibitors). (Author's abstract)
W89-00218

SPATIAL AND TEMPORAL DISTRIBUTION PATTERNS OF THREE TROPHIC LEVELS IN A SALINE LAKE,
California Univ., Santa Barbara. Dept. of Biological Sciences.
P. H. Lenz, S. D. Cooper, J. M. Melack, and D. W. Winkler.
Journal of Plankton Research JPLRD9, Vol. 8, No. 6, p 1051-1064, November 1986. 5 fig, 5 tab, 39 ref.

Descriptors: *Mono Lake, *Saline lake, *Ecology, *Grebes, *Limnology, *Trophic level, *Population dynamics, *Phytoplankton, Aquatic habitats, Aquatic animals, Food habits, Food chains, Lakes, California, Water birds, Brine shrimp, Patchiness, Predation, Zooplankton, Temporal distribution.

Horizontal distribution patterns of three trophic levels were investigated at Mono Lake, California, during the autumns of 1980 and 1981. Coefficients of variation for Artemia monica and grebes peaked in October of both years, whereas coefficients of variation for phytoplankton declined from August to November. Stable population gradients were observed in the Artemia population. In contrast, grebes were very mobile and their distributional patterns changed between sampling dates. Artemia and phytoplankton were negatively correlated during 1980, but no significant correlations occurred in 1981. Grebes and Artemia were positively correlated in October 1980 and 1981, suggesting active prey tracking by the grebes. Interactions between trophic levels may have contributed to the creation and maintenance of patchiness, although these effects appeared to be intermittent. (Author's abstract)
W89-00219

ZOOPLANKTON COMMUNITY GRAZING IN A HYPERTROPHIC LAKE (HARTBEESPOORT DAM, SOUTH AFRICA),
National Inst. for Water Research, Pretoria (South Africa).
A. C. Jarvis.
Journal of Plankton Research JPLRD9, Vol. 8, No. 6, p 1065-1078, November 1986. 5 fig, 1 tab, 51 ref.

Descriptors: *Limnology, *Hypertrophic lakes, *Reservoirs, *Zooplankton, *Population dynamics, *Species composition, *Primary productivity, *Daphnia, *Food habitats, Isotope studies, Radioactive tracers, Phytoplankton, Aquatic habitats, Food chains, Eutrophication, Lakes, Hartbeespoort Dam, Biomass, Seasonal variation, Cyanophta.

Seasonal abundance as total biomass and specific densities of the main herbivorous zooplankton (> 60 micron) in hypertrophic Hartbeespoort Dam from 1981 to 1983 are described. After spring zooplankton biomass maxima each year there followed a mid-summer decline in the Daphnia population and a shift to a smaller bodied cladoceran community dominated by Ceriodaphnia concomitant with a change from largely edible phytoplankton species to abundant colonial Microcystis. In situ community grazing rates were measured throughout 1983 using a 14C-labelled unicellular alga. Integrated community grazing rates measured in the aerobic water column were highest in December (260.2%/day) when Daphnia was abundant and the edible component of the phytoplankton was diminishing. Lowest integrated community grazing rates occurred in January-February (19.8-35.3%/day) and July (28.3%/day) when the phytoplankton was composed almost entirely of Microcystis, and Ceriodaphnia dominated the zooplankton community whereas food availability was low. Feeding in Ceriodaphnia was not hindered by abundant large Microcystis colonies; total biomass specific grazing rate was high when Ceriodaphnia dominated and low when Daphnia dominated the zooplankton community. Results indicate that in hypertrophic conditions it is unlikely that large filter-feeders such as Daphnia are able to retard or limit the development of Cyanophyceae blooms by high grazing pressure. (Author's abstract)
W89-00220

ROTIFERS OF WARRI RIVER, NIGERIA,
Benin Univ., Benin City (Nigeria). Dept. of Zoology.
A. B. M. Egborge, and P. Tawari.
Journal of Plankton Research JPLRD9, Vol. 9, No. 1, p 1-13, January 1987. 7 fig, 2 tab, 33 ref.

Descriptors: *Estuaries, *Nigeria, *Warri River, *Rotifers, *Population dynamics, *Species composition, Limnology, Aquatic habitats, Seasonal variation, Salt tolerance, Reproduction, Rivers.

The rotifer assemblage of the dendritic tidal Warri River was investigated at four sampling points from July 1981 to July 1982. Forty-one species of Rotifera were identified. Five of these (Anuraeopsis racenesi Berzins Keratella cochlearis macracontha Lauterborn, Monostyla lunaris Pawlowsky, M. stenroosi Meissner and Trichocerca similis grandis Hauer) are recorded for the first time in West Africa. The Warri River rotifers are 65% cosmopolitan and 20% pantropical, although there was no species limited to African waters only. The dominant rotifers in the Warri River were Keratella tropica and K. cochlearis. They were found from the predominantly freshwater sampling station at Udu Bridge to Warri and Orugbo Creek where low brackish water salinities and conductivities are observed from December or January to April each year. (Author's abstract)
W89-00222

SUMMER DYNAMICS OF THE DEEP CHLOROPHYLL MAXIMUM IN LAKE TAHOE,
Konstanz Univ. (Germany, F.R.). Limnological Inst.
T. G. Coon, M. Lopez, P. J. Richerson, T. M. Powell, and C. R. Goldman.
Journal of Plankton Research JPLRD9, Vol. 9, No. 2, p 327-344, March 1987. 6 fig, 65 ref. NSFDEB75-14273, DEB76-20341, and AEN74-22675 A01 and NASA Grant NAG5-217.

Descriptors: *Lake Tahoe, *Chlorophyll, *Limnology, *Phytoplankton, *Population dynamics, Zooplankton, Food habits, Food chains, Limiting nutrients, Lakes, Vertical distribution, Cyclotella, Diatoms, Light intensity, Biomass.

Vertical profiles of chlorophyll and phytoplankton biomass were measured in Lake Tahoe from July 1976 through April 1977. A deep chlorophyll maximum (DCM) persisted during summer and early autumn (July-October) near 100 m, well below the mixed layer and at the upper surface of the nutricline. The DCM coincided with the phytoplankton biomass maximum as determined from cell counts. In addition, the composition of the phytoplankton assemblage was highly differentiated with respect to depth. Cyclotella stelligera was the predominant species in the mixed layer while the major species in the DCM layer included C. ocellata and several green ultraplanktonic species. In situ cell growth plays a substantial role in maintaining the DCM, but sinking of cells from shallower depths and zooplankton grazing above the DCM persists at the boundary between an upper, nutrient-limited phytoplankton assemblage and a deeper, light-limited assemblage. (Author's abstract)
W89-00224

BACTERIAL RESPONSE TO SEASONAL CHANGES IN PRIMARY PRODUCTION AND PHYTOPLANKTON BIOMASS IN LAKE CONSTANCE,
Konstanz Univ. (Germany, F.R.). Limnological Inst.
M. Simon, and M. M. Tilzer.
Journal of Plankton Research JPLRD9, Vol. 9, No. 3, p 535-552, May 1987. 9 fig, 3 tab, 66 ref. Deutsche Forschungsgemeinschaft Grants Ti 115/3 and Ti 115/10-2.

Descriptors: *Lake Constance, *Aquatic bacteria, *Limnology, *Primary productivity, *Phytoplankton, Biomass, Eutrophication, Biodegradation, Decomposing organic matter, Chlorophyll a, Microorganisms, Zooplankton, Food habits, Food chains, Lakes, Population dynamics, Seasonal variation, Switzerland, Nanoplankton, Limnology, Cycling nutrients, Isotope studies.

Parameters characterizing bacterial biomass and metabolic activity are compared with phytoplankton biomass and daily primary production rates throughout the year. Between late March (before the onset of the phytoplankton spring bloom) and mid-July (diatom maximum), bacterial degradation of organic matter was more closely related to phytoplankton productivity than during the rest of the year. Bacterial production (as estimated by amino acid net uptake) was significantly correlated with concentrations of chlorophyll a and pheopigments. However, bacterial production was correlated less closely with primary production and only weakly with bacterial biomass. Bacterial biomass was also only weakly correlated with primary production but significantly with pheopigments. Numbers of active bacteria estimated by autoradiography covaried closely with bacterial production and cell numbers. Whenever bacterial production was low, enhanced proportions of amino acids were respired. Oxygen consumption measurements showed that the size fraction <3 micron contributed 25-75% to total respiration. On average, bacterial biomass comprised 11% of particulate organic matter and roughly equalled phytoplankton biomass. During the growing season, bacterial production in the uppermost 20 m comprised about 20% of phytoplankton production with large seasonal fluctuations. A tentative carbon budget of the euphotic zone including primary production, zooplankton grazing, bacterial production and sedimentation is presented. (Author's abstract)
W89-00225

NITRATE REDUCTASE ACTIVITY IN PHYTOPLANKTON FROM THE OSLO-FJORD, NORWAY,
Oslo Univ. (Norway). Dept. of Biology.
S. Kristiansen.
Journal of Plankton Research JPLRD9, Vol. 9, No. 4, p 739-748, July 1987. 3 fig, 4 tab, 17 ref.

Descriptors: *Oslo Fjord, *Nutrients, *Nitrates, *Enzymes, *Phytoplankton, Primary productivity, Chlorophyll a, Limiting nutrients, Species composition, Aquatic habitats, Biomass, Fjords, Estuaries, Cycling nutrients.

The activity of the enzyme nitrate reductase (NRA) was measured in natural populations of phytoplankton in the Oslofjord, Norway, and in culture experiments with 10 different species of phytoplankton. The NRA values from the culture experiments and from the natural samples were of the same order of magnitude. The NRA values, when expressed on a chlorophyll a basis, were highly species-variable. In general they were correlated to the nitrogen nutrient concentrations in the water. In order to use NRA as a guide to an understanding of the assimilation of nitrate, it is important to know the species composition of the phytoplankton. (Author's abstract)
W89-00226

SHORT-TERM VARIATIONS IN THE ZOOPLANKTON COMMUNITY RELATED TO WATER EXCHANGE PROCESSES IN THE GULLMAR FJORD, SWEDEN,
Kristenebergs Marinbiologiska Station, Fiskebackskil (Sweden).
O. Lindahl, and R. Perissinotto.
Journal of Plankton Research JPLRD9, Vol. 9, No. 6, p 1113-1132, November 1987. 6 fig, 1 tab, 37 ref.

Descriptors: *Estuaries, *Fjords, Gullmar Fjord, *Seasonal variation, *Zooplankton, *Species composition, Population dynamics, Biomass, Limnology, Aquatic habitats, Aquatic animals, Hydrodynamics, Prediction, Sweden, Sills.

Short-term variations in the zooplankton community in relation to hydrographical exchange processes were studied from February to April 1985 in the sill area of the Gullmar fjord, situated on the west coast of Sweden. It was concluded that the hydrodynamic processes were of great importance for the short-term variations in the zooplankton abundance and species composition. Furthermore, due to the complex nature of the exchange processes and zooplankton patchiness, the predictability of the development of the zooplankton community in the fjord is poor. Fractionated sampling in stratified waters is discussed, as well as the effect of different water retention times above and below the halocline. (Author's abstract)
W89-00228

NITRATE AND AMMONIUM UPTAKE BY PLANKTON IN AN AMAZON RIVER FLOODPLAIN LAKE,
Maryland Univ., Cambridge. Horn Point Environmental Labs.
T. R. Fisher, K. M. Morrissey, P. R. Carlson, L. F. Alves, and J. M. Melack.
Journal of Plankton Research JPLRD9, Vol. 10, No. 1, p 7-29, January 1988. 7 fig, 5 tab, 59 ref. NSF Grant DEB-78-23642, DEB-81-11398 and BSR-85-07494.

Descriptors: *Nitrate, Ammonium, *Nutrients, *Primary productivity, *Lake Calado, *Amazon River, *Phytoplankton, Light intensity, Cycling nutrients, Chlorophyll a, Biomass, Organic carbon, Lakes, Nitrates, Ammonium, Limiting nutrients, Kinetics, Brazil, Flooding, Flood plains, Tropical regions.

Uptake of ammonium and nitrate by plankton was measured in tropical Lake Calado, Brazil. Nitrate uptake was strongly influenced by light and was light saturated at 340 microE/sq m/sec. In contrast, uptake of ammonium was less influenced by light, and saturated at 250 microE/sq m/sec. Uptake rates of both forms of nitrogen were inhibited by up to 80% at light intensities higher than those required for saturation. Concentrations of ammonium and nitrate also had a strong influence on uptake rates. Half-saturation constants were usually greater than ambient concentrations, indicating that uptake rates at ambient concentrations were less than one-half of the saturated rates. Ammonium is the more important type of inorganic nitrogen for plankton of Lake Calado because nitrate concentrations remain low to undetectable except during periodic inputs of nitrate-rich water from the Amazon River. Using the observed dependence of uptake on concentration and light, maximum uptake rates per unit chlorophyll a were computed to be in reasonable agreement with rates derived from values for carbon uptake. (See also W89-08230) (Author's abstract)
W89-00229

REGENERATION AND UPTAKE OF AMMONIUM BY PLANKTON IN AN AMAZON FLOODPLAIN LAKE,
Maryland Univ., Cambridge. Horn Point Environmental Labs.
K. M. Morrissey, and T. R. Fisher.
Journal of Plankton Research JPLRD9, Vol. 10, No. 1, p 31-48, January 1988. 5 fig, 4 tab, 32 ref. NSF Grant DEB-78-23642, DEB-81-11398, and BSR-85-07494.

Descriptors: *Limnology, *Cycling nutrients, *Primary productivity, *Ammonium, *Phytoplankton, Chlorophyll a, Biomass, Lakes, Lake Calado, Nitrates, Amazon River, Mixing, Tropical regions, Brazil, Primary productivity, Isotope studies, Radioactive tracers.

Planktonic regeneration and uptake of ammonium was measured in Lake Calado on the floodplain of the Amazon River (Brazil). In the epilimnion of the lake, regeneration and uptake averaged 0.86 + or - 0.15 and 1.9 + or - 0.4 micron NH4/L/h respectively. Uptake exceeded regeneration under the ammonium-enriched conditions of our experimental incubations, but uptake and regeneration are in near-balance at in situ ammonium concentrations of < 1 micromolar. In experiments that simulated lake overturn, samples from the meta- and hypolimnion had higher rates of regeneration (1.4 + or - 0.6) and lower rates of uptake (0.89 + or - 0.53) than epilimnetic samples. During inflow of water from the Amazon River and a local stream, ammonium regeneration rates were similar to those measured in the epilimnion (0.84 + or - 0.22), but the uptake rates were lower (0.49 + or - 0.13). Although regeneration always exceeded uptake in the overturn and inflow experiments, ammonium did not accumulate. Rapid isotope dilution of the ammonium pool occurred in the incubations, and the effect of not accounting for isotope dilution could result in underestimating uptake rates by a factor of 2-5 in the epilimnion of this tropical lake. (See also W89-00229) (Author's abstract)
W89-00230

EFFECTS OF INCREASING SALINITY ON A CYANOBACTERIA BLOOM IN THE POTOMAC RIVER ESTUARY,
Academy of Natural Sciences of Philadelphia, Benedict, MD. Benedict Estuarine Research Lab.
K. G. Sellner, by R. V. Lacouture, and C. R. Parrish.
Journal of Plankton Research JPLRD9, Vol. 10, No. 1, p 49-61, January 1988. 7 fig, 2 tab, 24 ref.

Descriptors: *Salinity, *Cyanophyta, *Potomac River, *Estuaries, *Eutrophication, *Phytoplankton, *Population dynamics, Species composition, Spatial distribution, Salt tolerance, Photosynthesis, Biodegradation, Rivers, Microcystis, Aphanizomenon, Oxygen demand, Biomass.

From June through August, 1985, a bloom of the cyanobacterium Microcystis aeruginosa was observed in the upper Potomac River reaching densities of 193 million cells/L and 83% of total cells in the surface mixed layer. However, in regions typified by salinities of 1-2 ppt immediately downriver, the alga disappeared from the phytoplankton assemblage, never contributing > 17% of total phytoplankton numbers. In an attempt to determine the effect of increasing salinity on limiting horizontal distributions of cyanobacteria blooms in the Potomac River estuary, three laboratory experiments were conducted. Bloom samples collected from the river were exposed to daily salinity increases of 1-2 ppt through the addition of NaCl or a complement of full sea salts. Relative to samples receiving no salt supplement, densities of Microcystis spp. declined in salinity-stressed samples. However, total cyanobacteria remained constant or increased due to rapid growth of Aphanizomenon. The addition of a mixture of full sea salts favored aggregation of cyanobacteria, yielding an average of 132 cells/colony; 36 cells/colony were observed in populations maintained in river water and NaCl-supplemented samples. Chlorophyll concentrations declined slightly relative to assemblages receiving no salt additions while carbon fixation was reduced in salinity-stressed assemblages. These results suggest that salinities from 0.5 to 7 ppt, typical of the oligohaline region of the Potomac River, could limit the distribution of Microcystis-dominated blooms down-estuary. In addition, increasing salinities should result in the aggregation of photosynthetically inhibited cells and, through prolonged exposure to increasing osmotic stress, produce large, rapidly sinking detrital particles supporting microbial decomposition in oligohaline and mesohaline regions of the lower Potomac River estuary, perhaps perpetuating high microbial oxygen demand and anoxia in this portion of the river/estuary. (Author's abstract)
W89-00231

ROLE OF STORMS IN THE SUMMER SUCCESSION OF THE PHYTOPLANKTON COMMUNITY IN A SHALLOW LAKE (LAKE BALATON, HUNGARY),
Hungarian Natural History Museum, Budapest. Botanical Dept.
J. Padisak, L. G. Toth, and M. Rajczy.
Journal of Plankton Research JPLRD9, Vol.10, No. 2, p 249-265, March 1988. 10 fig, 2 tab, 43 ref.

Descriptors: *Lake Balaton, *Hungary, *Storms, *Limnology, *Phytoplankton, *Seasonal variation, *Population dynamics, Sediment transport, Wind erosion, Selection, Weather, Lakes.

Day-to-day studies were conducted of the phytoplankton of the largest shallow lake of Central Europe in the summer of 1976, 1977, and 1978. Wind-induced stirring-up of the sediment plays important role in the summer phytoplankton succession of the shallow lake. After storms algae with very small cell sizes show synchronous development. In long calm periods algae with larger cell sizes exhibit organized population dynamics. In calm periods a shift from r-selection to predominant K-selection can be suspected. After the next storm importance of r-selectionists again increases. Effect of changing growth- and loss rates on the population dynamics of the most abundant species is discussed based on measured generation times and calculated elimination. (Author's abstract)
W89-00232

SEDIMENTATION OF PHYTOPLANKTON POPULATIONS DOMINATED BY MICROCYSTIS IN A SHALLOW LAKE,
National Inst. for Environmental Studies, Tsukuba (Japan). Environmental Biology Div.
N. Takamura, and M. Yasuno.
Journal of Plankton Research JPLRD9, Vol.10, No. 2, p 283-299, March 1988. 9 fig, 1 tab, 34 ref. Grant-in-Aid of the Japanese Ministry of Education, Science and Culture 59740330.

Descriptors: *Eutrophic lakes, *Sedimentation, *Hypertrophic lakes, *Microcystis, *Sediment transport, *Phytoplankton, *Limnology, *Seasonal variation, *Population dynamics, Detritus, Diatoms, Particulate matter, Japan, Cyanophyta, Food chains, Lakes, Lake Kasumigaura, Biomass, Eutrophication, Sediment transport, Organic carbon.

The sedimentary flux of phytoplankton was measured using sediment traps in a shallow hypertrophic lake (Lake Kasumigaura), where Microcystis bloomed, from June to November 1983. The sediment traps were set at 0.5, 1.5 and 3.0 m depth in Takahamairi Bay (3.5 m depth). Microcystis spp. (including M. aeruginosa and M. viridis) in the traps were rare until early August, but increased thereafter. Sinking rates of Microcystis were 0.0045, 0.020 and 0.24 m/day in June-August, September and October respectively, which were far lower than those of Melosira (0.2-1.7 m/day) and Synedra (0.2-1.0 m/day). The total sedimentary fluxes of particulate organic carbon (POC) and that of algal carbon during the study period were 283.2 and 96.7 g C/sq m which were 59.5% and 20.3% of the gross primary production (475.8 g C/sq m) respectively. The sedimentary flux of living algae measured by algal counts was large in June but small in August and September. On the other hand, the flux of detritus obtained by subtracting total algal carbon from POC was small in June and July but large in August and September. Therefore diatoms, which appeared mostly in June, tended to sink as live algae, while Microcystis sank as detritus after being decomposed or consumed in the water. It was concluded from the results of carbon budget calculations and the respiration rate of the 1- to 20-micron fraction that the activity of decomposers or consumers increased greatly in the short period at the end of the bloom of Microcystis. (Author's abstract)
W89-00233

SPECIES DIVERSITY OF ALGAL FLORA IN VISHWAMITRI RIVER, BARODA (INDIA),
S.S.V.P. Santha's Science Coll., Dhule (India).
P.G. Dept. of Botany.
S. N. Nandan, and R. J. Patel.
Polskie Archiwum Hydrobiologii PAHYA2, Vol. 32, No. 1, p 1-6, 1985. 4 tab, 12 ref.

Descriptors: *Stream biota, *India, *Algae, *Vishwamitri River, *Rivers, *Species diversity, *Aquatic plants, Seasonal variation, Physical properties, Alkaline water, Cycling nutrients, Chemical oxygen demand, Pollution load, Aquatic habitats, Seasonal variation, Pollution index, Bioindicators.

Shannon's index of diversity was studied to analyze the structure of algal community in Vishwamitri river flowing through Baroda city during December, 1980 to December, 1982. Diversity index (DI) was calculated according to Shannon's function. All three stations selected did not show any difference in the mean values of DI, but the values of each month showed slight variation. Diversity index was correlated with 17 physicochemical parameters. It showed direct relationship with carbonate, total alkalinity, nitrate, phosphate, calcium and total solids whereas it showed inverse relationship with COD at all 3 stations. DI may be a good index for determining the degree of pollution. (Author's abstract)
W89-00234

HABITAT REQUIREMENTS AND BIOINDICATOR VALUE OF THE MAIN COMMUNITIES OF AQUATIC VEGETATION IN NORTH-EAST POLAND,
Warsaw Univ. (Poland). Dept .of Phytogeography.
S. Klosowski.
Polskie Archiwum Hydrobiologii PAHYA2, Vol. 32, No. 1, p 7-29, 1985. 6 fig, 3 tab, 38 ref.

Descriptors: *Ecosystems, *Ecological distribution, *Poland, *Limnology, *Species composition, *Bioindicators, *Limiting nutrients, *Aquatic plants, *Aquatic habitats, Plant physiology, Pollution load, Nutrients, Phytoplankton, Physical properties, Population dynamics.

Comparison of the phytosociological data as well as of the physical and chemical properties of water and substrate of the phytocenoses of five aquatic communities: Potamogetonetum perfoliati, P. lucentis, P. natantis, Nupharo-Nymphaeetum albae and Hydrocharitetum morsus-ranae, indicates that the properties of the habitat evidently influence phytosociological differentiation of the communities. The substrate and water represent two, in a great measure independent habitat components whose importance for the various communities is different. Nearly each aquatic vegetation community, singled out on the grounds of floristic dominance, exhibits some indicator value. With respect to aquatic habitat, the greatest bioindicator value is displayed by Potamogetonetum natantis which is indicative of waters relatively poor in nutrients (mesotrophic waters). (Author's abstract)
W89-00235

CHEMICAL CHARACTERISTICS OF BOTTOM SEDIMENT TOP LAYER IN SZCZYTNO MALE LAKE,
Wyzsza Szkola Nauczycielska w Slupsku (Poland). Dept. of Chemistry.
J. Trojanowski, C. Trojanowska, and H. Ratajczyk.
Polskie Archiwum Hydrobiologii PAHYA2, Vol. 32, No. 2, p 99-112, 1985. 3 fig, 1 tab, 26 ref.

Descriptors: *Eutrophic lakes, *Poland, *Bottom sediments, *Szczytno Male Lake, *Lake sediments, *Limnology, *Cycling nutrients, Heavy metals, Sediment-water chemistry, Mineralization, Aquatic habitats, Organophosphorus compounds, Lakes, Chemical analysis.

In chemical analysis of the top layer (about 15 cm) of bottom sediments of Szczytno Male Lake, silica was found to be the main component; thus, they can be classified as silicate sediments. Calcium carbonate (0.3-34.8%) was the next most-predominant component. Another group of bottom sediments had a lower silica level; their content of organic matter (11.0-29.7%) and the C/N ratio (15.8-21.9) indicate that they are of gyttja type. Protein phosphorus was 42.6% of total organic P, lipid phosphorus was 32.8 and nuclear phosphorus was 24.6%. In bottom sediments of this lake, iron, aluminum and manganese probably occur mainly as phosphates. Chemical composition of bottom sediments and their mineralization rate indicate that Szczytno Male is an eutrophic lake. (See also W89-00238 thru W89-00241, W89-00256, and W89-00262) (Author's abstract)
W89-00237

PRIMARY PRODUCTION IN LAKES WITH CAGE TROUT CULTURE,
Wyzsza Szkola Nauczycielska w Slupsku (Poland). Dept. of Chemistry.
J. Trojanowski, C. Trojanowska, and H. Ratajczyk.
Polskie Archiwum Hydrobiologii PAHYA2, Vol. 32, No. 2, p 113-129, 1985. 5 fig, 4 tab, 24 ref.

Descriptors: *Aquaculture, *Trout, *Primary productivity, *Limnology, *Lakes, Light penetration, Letowo Lake, Szczytno Male Lake, Aquatic habitats.

In Letowo and Szczytno Male lakes (West Pomerania), the primary production was highest in the cage trout culture areas; these areas were also characterized by the highest concentrations of total phosphorus and total nitrogen as well as by the lowest Secchi-disc visibility. Phosphorus content was the production-limiting factor. At depths exceeding 2 m in the trout-culture area, light intensity became the factor limiting production. Primary production was always highest in summer; in summer 1982, the production in Letowo Lake averaged 36.1 mg C/cu m/hr, and was higher in Szczytno Lake (42.7 mg C/cu m/hr), probably owing to the higher content of total phosphorus. There were highly significant correlations between primary production, on one hand, and Secchi-disc visibility, content of chlorophyll a in the phytoplankton, and total phosphorus and total nitrogen concentrations in water, on the other. The multiple correlation coefficients r, at significance level 0.05, was 0.945 for Lake Letowo and 0.933 for Lake Szczytno Male. (See also W89-00237, W89-00239 thru W89-00241, W89-00256 and W89-00262) (Author's abstract)
W89-00238

SORPTION OF CATIONS BY BOTTOM SEDIMENTS OF SZCZYTNO MALE AND LETOWO LAKES, WITH CAGE TROUT CULTURE,
Wyzsza Szkola Nauczycielska w Slupsku (Poland). Dept. of Chemistry.
K. Korzeniewski, and A. Moczulska.
Polskie Archiwum Hydrobiologii PAHYA2, Vol. 32, No. 2, p 131-144, 1985. 8 fig, 4 tab, 11 ref.

Descriptors: *Bottom sediments, *Aquaculture, *Sorption, *Cations, *Lake sediments, *Limnology, Trout, Letowo Lake, Szczytno Male Lake, Aquatic habitats, Fish hatcheries, Heavy metals, Seasonal variation, Chemical analysis, Decomposing organic matter, Lakes.

Various types of bottom sediments of two lakes with cage trout culture were studied. Total sorption capacity, sum of exchangeable bases, as well as total content of H(+) and Al(3+) ions and of trace amounts of other cations, were determined. Exchangeable cations were extracted from the sorption complex and from the sediment surface, and the contents of Ca(2+), Mg(2+), Na(+) and K(+) were measured. Determination was made of the ratio of exchangeable ions bound in the sorption complex of bottom sediments to ions adsorbed on the surface of sediment particles, as a function of the kind of cations, composition of bottom sediments and season. A rise of organic matter content in bottom sediments accompanied an increase in the exchange sorption capacity. The ion-exchange capacity of bottom sediments increased in spring. (See also W89-00237 thru W89-00238, W89-00240 thru W89-00241, W89-00256, and W89-00262) (Author's abstract)
W89-00239

NITROGEN AND PHOSPHORUS BALANCE IN LAKE SZCZYTNO MALE,
Wyzsza Szkola Nauczycielska w Slupsku (Poland). Dept. of Chemistry.
J. Trojanowski.
Polskie Archiwum Hydrobiologii PAHYA2, Vol. 32, No. 2, p 145-156, 1985. 4 fig, 3 tab, 20 ref.

Descriptors: *Aquaculture, *Szczytno Male Lake, *Lakes *Nitrogen, *Phosphorus, *Limnology, *Water chemistry, *Cycling nutrients, Seasonal variation, Fish hatcheries, Pollution load, Flow, Trout, Szczytno Male Lake.

Nitrogen and phosphorus balances were determined during the yearly cycle of trout culture; it appeared that in that period 406.6 g//sq m of nitrogen and 36.0 g/sq m of phosphorus had been brought into Lake Szczytno male, where 0.56 g N/sq m and 0.03 g P/sq m remained. Only phosphorus (0.01 g/sq m) accumulated in the sediment. The main source of the nutrient loading was the inflow from Szczytno Duze Lake which contributed 97.4% of the total loading of nitrogen and 94.6% of the total loading of phosphorus. The average rate of flow was 5.48 cu m/s. The second largest input source was the trout cages (1.39% N and 4.9% P). It was observed that the amount of flowing water affects the monthly concentration of nutrients, which changed with flow-rate changes. (See also W89-00237 thru W89-00239, W89-00241, W89-00256, and W89-00262) (Author's abstract)
W89-00240

HYDROCHEMICAL STUDY OF LAKE SZCZYTNO MALE WITH TROUT CAGE CULTURE,
Wyzsza Szkola Nauczycielska w Slupsku (Poland). Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W89-00241

THERMAL ECOLOGY OF SURINSAR, A SUBTROPICAL FRESHWATER LAKE IN JAMMU, INDIA,
Jammu Univ. (India).
M. K. Jyoti, H. S. Sehgal, and P. S. Sodhi.
Polskie Archiwum Hydrobiologii PAHYA2, Vol. 33, No. 1, p 9-20, 1986. 7 fig, 4 tab, 15 ref.

Descriptors: *Lakes, *Subtropic Zone, *India, *Lake Surinsar, *Limnology, *Temperature effects, Seasonal variation, Thermocline, Aquatic habitats, Aquatic plants, Thermal stratification, Lake classification.

Surface temperature shows a minimum in winter (January) and maximum in summer (June to August). Changes in water temperature follow closely those in air temperature. Aquatic vegetation plays a substantial role in temperature increase and causes horizontal differences. Thermal stratification is prolonged (for 9 months in a year) and there is only one circulation period in winter. Advancement of summer thickens the thermocline while increased wind action, decreased day length and heavy rainfall it causes to sink to a deeper layer. Based upon thermal characteristics and geographical locations, it is proposed that Lake Surinsar and other such lakes that possess similar thermal properties are proposed to be called as 'Subtropical-Monoholomictic' lakes. (Author's abstract)
W89-00242

CONCENTRATIONS OF NITROGEN AND PHOSPHORUS IN WATERS OF TWO HYPERTROPHIC LAKES AND THEIR EFFECT ON THE QUANTITY OF PHYTOPLANKTON BIOMASS,
Poznan Technical Univ. (Poland). Inst of Environmental Engineering.
J. Panczakowa, and T. Szyszka.
Polskie Archiwum Hydrobiologii PAHYA2, Vol. 33, No. 2, p 151-164, 1986. 8 fig, 2 tab, 25 ref.

Descriptors: *Lakes, *Eutrophic lakes, *Nitrogen, *Phosphorus, *Limnology, *Phytoplankton, *Biomass, *Cycling nutrients, *Aquatic habitats, Aquatic plants, Seasonal variation, Limiting nutrients, Water chemistry, Chemical analysis, Jelonek Lake, Swietokrzyskie Lake.

Water nitrogen and phosphorus concentrations were several times higher in hypertrophic dimictic Swietokrzyskie Lake (maxima: 24.3 mg Tot-N/cu dm in spring, and 2.15 mg Tot-P/cu dm in summer) than in polymictic Jelonek Lake (maxima: 13.6 mg Tot-N/cu dm in spring, and 0.94 mg Tot-P/cu dm in summer). During periods of predominance of Aphanizomenon flos-aquae, the phytoplankton biomass increased with a rise of the Tot-P concentration. High concentrations of NH4-N inhibited the development of phytoplankton. There were significant correlations between the phytoplankton biomass and the NH4-N concentration and the Tot-N:Tot-P ratio; these correlations were positive for Jelonek Lake and negative for Swietokrzyskie Lake. (Author's abstract)
W89-00245

DIURNAL FLUCTUATIONS OF PHOSPHORUS FORMS IN LAKE WATER AND SESTON IN PLUSS-SEE,
Polish Academy of Sciences, Warsaw. Inst. of Geography.
J. Golachowska.
Polskie Archiwum Hydrobiologii PAHYA2, Vol. 33, No. 2, p 165-175, 1986. 4 fig, 27 ref.

Descriptors: *Phosphorus, *Lakes, *Seston, *Limnology, *Cycling nutrients, Organophosphorus compounds, Optical properties, Metabolites, Aquatic habitats, Pluss-See, Chemical analysis, Diurnal distribution, Light intensity.

Diel vertical changes of concentration of some P-forms in lake water and lake seston were studied in the surface layer. The diel variability of P-forms concentration in lake water (total phosphorus, dissolved organic phosphorus, dissolved inorganic phosphorus, total organic phosphorus) and in lake seston (total seston phosphorus, acid soluble phosphorus, lipid phosphorus, nucleic acid phosphorus and protein phosphorus) showed the occurrence of periodicity with an increase during the light period and a trend to decrease during the dark phase. The positive correlation of total seston phosphorus and total organic phosphorus (r=0.54) suggested that diurnal fluctuations in phosphorus concentration were related to the metabolism of living organisms present in lake water. (Author's abstract)
W89-00246

EFFECT OF WITOBELSKIE AND LODZKO-DYMACZEWSKIE LAKES ON PHYTOPLANKTON OF SAMICA STESZEWSKA RIVER,
Adam Mickiewicz Univ., Poznan (Poland). Dept. of Hydrobiology.
K. Piescikowski.
Polskie Archiwum Hydrobiologii PAHYA2, Vol. 33, No. 2, p 189-196, 1986. 3 fig, 16 ref.

Descriptors: *Stream biota, *Witobelskie Lake, *Lodzko-Dymaczewskie Lake, *Poland, *Samica Steszewska River, *Phytoplankton, *Limnology, Aquatic habitats, Aquatic plants, Species composition, Population dynamics, Lakes.

The phytoplankton of Samica Steszewska River, situated in the Great Poland National Park was investigated in the summer seasons of 1981 and 1982. The phytoplankton of the river after flowing through two lakes of a different limnological nature (Witobelskie--Eutrophic, Polymictic--and Lodzko-Dymaczewskje--Stratified, Dimictic) were compared with the phytoplankton from a river segment not influenced by these lakes. There were considerable differences in the qualitative and quantitative composition of phytoplankton between water samples from various sampling stations. The differences involved elimination of forms derived from the periphyton and benthos as well as the appearance of new taxa typical of lakes (cryptophytes, pyrrophytes) in the river phytoplankton. (Author's abstract)
W89-00247

IMPACTS OF NAVIGATION ON RIVERINE FISH PRODUCTION IN THE UNITED STATES,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Fisheries and Wildlife Sciences.
For primary bibliographic entry see Field 6G.
W89-00248

FISH PRODUCTION IN THE KANAWHA RIVER AND ITS RELATION TO BARGE TRAFFIC,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Fisheries and Wildlife Sciences.
For primary bibliographic entry see Field 6G.
W89-00249

ESTIMATION OF PHYTOPLANKTON BIOMASS AND PRODUCTION, AND ORGANIC MATTER DECOMPOSITION IN THREE SMALL FIELD-PONDS,
Polish Academy of Sciences, Turew. Dept. of Agrobiology.
J. Jurkowska.
Polskie Archiwum Hydrobiologii PAHYA2, Vol. 34, No. 1, p 35-49, 1987. 8 fig, 4 tab, 32 ref.

Descriptors: *Limnology, *Farming, *Ponds, *Phytoplankton, *Biomass, *Productivity, *Water pollution effects, *Decomposing organic matter, Pollution load, Agricultural chemicals, Cycling nutrients, Trophic level, Species composition, Aquatic habitats, Aquatic plants, Reservoirs.

The phytoplankton of three field-ponds situated in a terrain with intensive farming activities was investigated. The ponds differed in their surroundings, being in a dissimilar measure exposed to pollutants running off from fields. The biomass of phytoplankton (B = 70.01 g/cu m) and its production (P = 2977 kJ/sq m season) as well as the decomposition of organic matter (D = 2445 kJ/sq m season) were greatest in the pond exposed to the highest input of nutrients. Cultivated fields approach the borders of this pond; moreover, it serves as a watering place for cattle, creating an additional source of pollution. It can be assumed that the trophic state of ponds and their phytoplankton composition are closely related to their surroundings, and that barriers in the form of helophytes, meadows, shrubbery etc. may effectively protect these reservoirs from excessively high trophic levels. (Author's abstract)
W89-00252

LIMNOCORRAL EXPERIMENTS IN A EUTROPHIC LAKE - EFFECTS OF FISH ON THE PLANKTONIC AND CHEMICAL CONDITIONS,
Direktoratet for Vilt og Ferskvannsfisk, Aas (Norway). Fish Research Div.
A. Langeland, J. I. Koksvik, Y. Olsen, and H. Reinertsen.
Polskie Archiwum Hydrobiologii PAHYA2, Vol. 34, No. 1, p 51-65, 1987. 6 fig, 5 tab, 52 ref.

Descriptors: *Fish, *Lakes, *Limnology, *Fish establishment, *Eutrophic lakes, *Cycling nutrients, *Ecosystems, *Limiting nutrients, Aquatic habitats, Plankton, Biomass, Primary productivity, Optical properties, Light quality, Daphnia, Algae, Norway.

An experiment was performed in two large enclosures in the eutrophic Lake Haugatjern in Central Norway. One of the corrals was stocked with whitefish equivalent to near 700 kg/ha while the other corral developed without the presence of fish. During the experimental period of 2 1/2 months in the summer of 1980, the enclosures developed differently; higher levels of particulate phosphorus, phytoplankton biomass, phytoplankton production, sedimented carbon and rotifer biomass were found in the fish corral, while the water transparency and pH were higher in the corral without fish. Higher mean biomass of cladocerans and copepods as well as larger individuals of Daphnia galeata were recorded in the corral without fish. This indicated a higher availability of phosphorus, the limiting nutrient for algal growth, in the corral with fish. The lake was treated with rotenone in the autumn of 1980. A comparison of the physical, chemical and biotic conditions in the lake during the pre and post years, yielded similar conclusions as those drawn from the enclosure experiments. (Author's abstract)
W89-00253

SORPTION PROPERTIES OF BOTTOM SEDIMENTS OF SZCZYTNO MALE AND LETOWO LAKES,
Wyzsza Szkola Nauczycielska w Slupsku (Poland). Dept. of Chemistry.
J. Trojanowski.
Polskie Archiwum Hydrobiologii PAHYA2, Vol. 34, No. 2, p 149-161, 1987. 11 fig, 1 tab, 16 ref.

Descriptors: *Sorption, *Sediments, *Szczytno Male Lake, *Letowo Lake, *Limnology, *Poland, *Cycling nutrients, *Water chemistry, Correlation analysis, Magnesium, Chlorides, Iron, Aluminum, Sulfates, Hydrogen ion concentration, Decomposing organic matter, Anions, Lakes.

The content of exchangeable phosphorus in bottom sediments of Szczytno Male and Letowo lakes depends on the concentrations of organic matter, phosphate phosphorus, iron and aluminum in these sediments. The coefficients of correlation between the contents of exchange phosphorus and of the above-mentioned components of bottom sediments are very high, amounting to 0.92-0.98. For bottom sediments with a calcium carbonate content not exceeding 2%, the total exchange capacity with respect to phosphate anions was determined. A change in water pH within the range of 5.0-9.0 alters the desorption of Ca(+2), Mg(+2), Fe(+2), Cl(-) and SO4(-2) ions from bottom sediments to water. The release of cations from bottom sediments is particularly sensitive to these changes, whereas the desorption of anions is less dependent on pH of the environment. (See W89-00237 thru W89-00241 and W89-00252) (Author's abstract)
W89-00256

CHANGES IN CHLOROPHYLL CONTENTS OF SWIETOKRZYSKIE LAKE PHYTOPLANKTON, AS RELATED TO QUALITATIVE AND QUANTITATIVE FLUCTUATIONS OF PHYTOPLANKTON DENSITY AND OF THE PHYSICOCHEMICAL CONDITIONS IN THIS LAKE IN SUMMER 1979,
Adam Mickiewicz Univ., Poznan (Poland). Dept. of Hydrobiology.
For primary bibliographic entry see Field 5C.
W89-00257

QUALITATIVE AND QUANTITATIVE CHANGES IN PHYTOPLANKTON ON THE BACKGROUND OF PHYSICOCHEMICAL CHANGES IN THE WATER OF SWIETOKRZYSKIE LAKE IN THE YEARS 1977-1979,
Adam Mickiewicz Univ., Poznan (Poland). Dept. of Hydrobiology.
For primary bibliographic entry see Field 5C.
W89-00258

DIFFERENTIATION OF THE PHYSICAL AND CHEMICAL PROPERTIES OF BOTTOM SEDIMENTS IN PHYTOCENOSES OF MYRIOPHYLLETUM VERTICILLATI SOO 1927, POTAMOGETONETUM NATANTIS SOO 1927 AND HYDROCHARITETUM MORSUS-RANAE LANGENDONCK 1935 ASSOCIATIONS,
Warsaw Univ. (Poland). Dept .of Phytogeography.
H. Tomaszewicz.
Polskie Archiwum Hydrobiologii PAHYA2, Vol. 34, No. 2, p 215-230, 1987. 4 tab, 37 ref.

Descriptors: *Phytocenoses, *Eutrophic lakes, *Sediments, *Limnology, *Aquatic habitats, *Wronki Lake, *Poland, Aquatic plants, Spatial distribution, Physical properties, Chemical properties, Lakes, Vertical distribution, Spatial distribution.

The vertical and horizontal differentiation of lake-bottom sediments was studied with respect to their

physical and chemical properties, to a 1-m depth, in phytocenoses of three aquatic associations. The three associations were immediately adjacent to each other and developing under seemingly very similar habitat conditions. The lake studied (Wronki Lake, Poland) was at the final stage of plant overgrowth, with the bottom covered by a thick layer of organic sediments. There were very big differences between sediments in terms of the vertical distribution of the major Physicochemical parameters. The analogous strata within the different phytocensus differed in the contents of various components. It was found that the physical properties of the substrate are one of the essential causes of the differences in aquatic vegetation within this small area. (Author's abstract)
W89-00259

EFFECT OF DRAINAGE BASIN ON HEAVY METAL CONCENTRATIONS IN STREAM WATERS IN THE NIEPOLOMICE FOREST,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5B.
W89-00260

FACTORS FORMING THE LEVEL AND DYNAMICS OF NUTRIENT RUNOFF FROM AN AGRICULTURAL WATERSHED,
Institute of Meteorology and Water Management, Warsaw (Poland).
For primary bibliographic entry see Field 5B.
W89-00261

CHLOROPHYLL RELATIONSHIPS IN LETOWO AND SZCZYTNO MALE LAKES, WITH TROUT CAGE CULTURE,
Wyzsza Szkola Nauczycielska w Slupsku (Poland). Dept. of Chemistry.
J. Trojanowski, H. Ratajczyk, C. Trojanowska, and K. Korzeniewski.
Polskie Archiwum Hydrobiologii PAHYA2, Vol. 34, No. 3, p 297-308, 1987. 6 fig, 1 tab, 19 ref.

Descriptors: *Trout, *Chlorophyll a, *Limnology, *Optical properties, *Aquaculture, *Eutrophication, *Phosphorus, Transparency, Vertical distribution, Poland, Correlation analysis, Seasonal variation, Szczytno Male Lake, Letowo Lake, Aquatic habitats, Lakes.

In years 1981-1983, in two lakes with trout cage culture (Letouro and Szczytno Male Lakes, Poland) determination was made of chlorophyll a contents in vertical profile of lakes as a function of time, in relation to water transparency and total phosphorus concentration. The average maximal chlorophyll a contents in summer fluctuated around the level of about 20 mg/cu m. Waters in the region of culture cages were richest in chlorophyll. In general, Szczytno Male Lake exhibited somewhat lower chlorophyll a levels than Letowo Lake. Statistical analysis testified to a very strong, significant correlation between chlorophyll a and total phosphorus concentrations. Moreover, the chlorophyll content in summer was correlated with total phosphorus level in spring. (See also W89-00237 thru W89-00241 and W89-00256) (Author's abstract)
W89-00262

CHERNOBYL 134CS, 137CS, AND 210PB IN HIGH MOUNTAIN LAKE SEDIMENT: MEASUREMENTS AND MODELING OF MIXING PROCESS,
Universite Scientifique et Medicale de Grenoble (France). Lab. de Spectrometrie Physique.
For primary bibliographic entry see Field 5B.
W89-00271

WOUND FIBERGLASS DEPTH FILTERS AS A LESS EXPENSIVE APPROACH FOR THE CONCENTRATION OF VIRUSES FROM WATER,
Institut Armand-Frappier, Laval (Quebec). Centre de Recherche en Virologie.
For primary bibliographic entry see Field 5A.
W89-00279

STATISTICAL CONSIDERATIONS ASSOCIATED WITH THE USE OF THE HETEROTROPHIC ACTIVITY METHOD FOR ESTIMATING V SUB MAX AND K' FOR AQUATIC ENVIRONMENTS,
Laurentian Univ., Sudbury (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 7C.
W89-00280

PCB-RESISTANT DIATOMS IN THE HUDSON RIVER ESTUARY,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
For primary bibliographic entry see Field 5C.
W89-00284

SPARTINA ALTERNIFLORA DIE-BACK IN LOUISIANA: TIME-COURSE INVESTIGATION OF SOIL WATERLOGGING EFFECTS,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
I. A. Mendelssohn, and K. L. McKee.
Journal of Ecology JECOAB, Vol. 76, No. 2, p 509-521, June 1988. 4 fig, 3 tab, 39 ref.

Descriptors: *Salt marshes, *Water pollution effects, *Aquatic plants, *Grasses, *Louisiana, *Waterlogging, Marshes, Sulfides, Soil chemistry, Hydrogen ion concentration, Saline soils, Soil environment.

Transplantation of streamside Spartina alterniflora swards into the more waterlogged and less productive inland marsh caused rapid decreases in soil redox potential and increases in interstitial water sulfide and NH4 concentrations and root alcohol dehydrogenase activity. One year later, standing crops in these transplanted swards were significantly reduced compared to their streamside controls. Reciprocal transplantation from inland to streamside resulted in the amelioration of the detrimental conditions associated with the waterlogged inland marsh and in an increase in standing crop to levels equivalent to streamside controls. Soil salinity and pH were not significant factors in causing reduced growth of S. alterniflora. Sulfide toxicity, in combination with extended periods of anaerobic metabolism in the roots, appeared to be a major factor associated with reduced growth of S. alterniflora and may be a cause of dieback in these marshes. (Author's abstract)
W89-00286

EXPERIMENTAL STUDIES ON THE RESILIENCY OF FLOATING TYPHA MATS IN A FRESHWATER MARSH,
New Brunswick Univ., Fredericton. Fire Science Centre.
B. O. Krusi, and R. W. Wein.
Journal of Ecology JECOAB, Vol. 76, No. 1, p 60-72, March 1988. 7 fig, 1 tab, 23 ref.

Descriptors: *Marshes, *Typha, *Aquatic plants, *Marsh plants, Marsh management, Fire, Water level, Population dynamics, Seasonal variation, Flooding, Drainage, Bay of Fundy, Incineration.

The phenology of Typha in floating mats, following drainage or seasonal burning or both, in marshes where water level can be controlled, near the Bay of Fundy (New Brunswick, Canada), was explored. On both drained and flooded areas, four burning treatments (spring, summer, autumn and no burning) were superimposed in 1981. The fires were more intense than would occur naturally, to establish resistance to change. Drainage and subsequent burning in summer reduced the Typha standing crop, by the end of the vegetation period following the treatments, to 20% of that in the flooded, unburned treatment. Typha survived the disturbance and no major shifts in species composition were observed. The results suggest that the Typha floating mat is resilient and will recover quickly from the range of drying and burning regimes that could be imposed under the normal climatic conditions of the Bay of Fundy area. It is hypothesized from the present short-term study that these flooded areas may move toward bog-like conditions in the absence of continued and severe human disturbance. (Author's abstract)
W89-00287

HABITAT SUITABILITY AND FISH PRODUCTION: A MODEL EVALUATION FOR ROCK BASS IN TWO VIRGINIA STREAMS,
Virginia Cooperative Wildlife Research Unit, Blacksburg.
P. Pajak, and R. J. Neves.
Transactions of the American Fisheries Society TAFSAI, Vol. 116, No. 6, p 839-850, November 1987. 1 fig, 5 tab, 49 ref.

Descriptors: *Habitats, *Bass, *Model studies, Streams, Virginia, Biomass, Population dynamics, Seasonal variation, Fish migration, Temporal variation.

A habitat suitability index (HSI) model for rock bass Ambloplites rupestris was developed from available suitability curves and field tested by comparing HSI and habitat units with seasonal standing stock, biomass, and production of rock bass in two fourth-order streams in Virginia. Consistent ranking between HSI and mean standing stocks for the study year was observed only for 250-m stream sections, the largest spatial unit of comparison. In contrast, changes in HSI explained no more than 22% of the variability in mean standing stocks in 50-m subsections of Back Creek, and were not significantly correlated with standing stocks in Little Walker Creek. Factors that apparently contributed to low correlations and ranking success included geographically homogeneous habitat and seasonal fish movements, as well as potentially important variables such as depth and cover that are not features of the tested HSI models. Annual discharge and fish distribution data further suggested that physical habitat was more limiting to populations of rock bass in the fall, not during the summer low-flow period as previously assumed. Unmeasured temporal variability in the environment may have been equally important in limiting presumed carrying capacities in study streams. Annual production for rock bass was nearly identical in both streams and averaged 1.04 g/sq m/yr. This similarity in annual production was consistent with the habitat homogeneity implied by the narrow range of observed HSIs. Validation of this HSI model and similar short-term assessments of habitat quality would be more likely if study sections included the home range or annual habitat requirements of all life stages of the target species. Additional quantitative data on species-habitat relationships and systematic evaluation of individual suitability indices should also improve testing of aggregate HSI models. (Author's abstract)
W89-00294

SUSCEPTIBILITY OF YOUNG-OF-THE-YEAR FISHES TO DOWNSTREAM DISPLACEMENT BY FLOODING,
Oklahoma Univ., Norman. Dept. of Zoology.
B. C. Harvey.
Transactions of the American Fisheries Society TAFSAI, Vol. 116, No. 6, p 851-855, November 1987. 3 fig, 20 ref. NSF Grant BSR-8501200.

Descriptors: *Flooding, *Streamflow, *Fish migration, Drift, Streams, Brier Creek, Fish populations.

The downstream displacement of young-of-the-year fishes (primarily centrarchids and cyprinids < 25 mm total length, TL) was examined by field sampling of drift during floods and by an experiment conducted in 4.9-m-long artificial stream channel. The pattern of drift during a June 1985 flood (stage increase of 3.2 m) in Brier Creek, Oklahoma, indicated that both centrarchids and cyprinids smaller than 10 mm TL were extremely susceptible to downstream displacement. Drift rates of larger fish (10-25 mm) during both the June flood and a smaller flood (stage increase of 0.4 m) in July 1985 suggested that these fish were much less susceptible to displacement. The rapid decline in susceptibility to displacement with increase in size from the field study coincided with results obtained in the artificial channel. These results suggest that the effects of floods on stream fish communities can depend on small differences

in the timing of reproduction and of flooding. (Author's abstract)
W89-00295

NUTRIENT AND LIGHT LIMITATION OF ALGAE IN TWO NORTHERN CALIFORNIA STREAMS,
California Univ., Davis. Dept. of Land, Air and Water Resources.
W. R. Hill, and A. W. Knight.
Journal of Phycology JPYLAJ, Vol. 24, No. 2, p 125-132, June 1988. 4 fig, 6 tab, 31 ref. California State Water Resources Research Institute Project CA-05-1985, and University of California Water Resources Center Project UCAL-WRC-W-651.

Descriptors: *Algae, *Nutrients, *Streams, *California, *Light penetration, Limiting factors, Nitrogen, Phosphorus, Biomass, Nitrates, Algal growth.

Nutrient-diffusing substrates were used to investigate nutrient limitation of attached algal assemblages in a shaded stream and an unshaded stream in northern California. Water from both streams contained low levels of nitrogen (< 14 micrograms/L) and very low N:P ratios (<2). After 31 days of colonization and growth, attached algal biomass on nitrate-diffusing substrates was significantly greater than on control substrates in the unshaded stream. Nitrate-diffusing substrates also supported larger numbers of grazing insects in the unshaded streams. The prostrate diatoms Achnanthes Lanceolata Breb. and Coconeis placentula Ehr. displayed the most consistent positive responses to nitrate enrichment. Nutrient enrichment did not increase the accumulation of algal biomass in the shaded stream, but algal biomass was significantly greater at sites located under openings in the tree canopy, implicating light as a limiting factor in this stream. Several Navicula and Nitzschia species, and one unidentified Gomphonema species, were positively associated with higher light levels in the shaded stream. Shade appears to be the primary factor limiting algal growth in small northern California streams, but when its effect is reduced by logging, the inherently low levels of nitrogen in these streams can become limiting. (Author's abstract)
W89-00296

PATTERNS OF EPIPELIC ALGAL DISTRIBUTION IN AN ACIDIC ADIRONDACK LAKE,
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Biology.
D. A. Roberts, and C. W. Boylen.
Journal of Phycology JPYLAJ, Vol. 24, No. 2, p 146-152, June 1988. 5 fig, 1 tab, 36 ref.

Descriptors: *Algae, *Acidic waters, *Lakes, Distribution patterns, Adirondack Park, New York, Diatoms, Cyanophyta, Bacteria, Seasonal variation, Epilimnion.

The biovolume and species composition of epipelic algae along sediment depth gradients were samples seasonally in an acidic oligotrophic lake in the Adirondack Park in New York State. The epipelic algal community of Woods Lake (Herkimer Co., NY) was dominated by diatoms and cyanobacteria. Distinct depth zonation patterns of community composition were evident. Total algal biovolume increased with depth due to a dense cyanobacterial mat on the sediments in deeper water (5-8 m). This mat was dominated by a single species of cyanobacteria, Hapalosiphon pumilus (Kutz) Kirchner, which accounted for the late summer maximum in total biovolume at 7 m. The shallower (1-4 m) epipelic communities were dominated by diatoms, which showed a spring maximum in total biovolume and were dominated by Fragilaria acidobiontica Charles, navicula tenuicephala Hust. and N. subtilissima Cl. (Author's abstract)
W89-00298

ENDANGERED WOUNDFIN AND WATER MANAGEMENT IN THE VIRGIN RIVER, UTAH, ARIZONA, NEVADA,
Nevada Univ., Las Vegas. Dept. of Biological Sciences.
For primary bibliographic entry see Field 6G.
W89-00311

UNIONID (MOLLUSCA:BIVALVIA) FAUNA OF THE SHENANGO RIVER IN MERCER COUNTY, PENNSYLVANIA,
Pennsylvania State Univ. Shenango Valley Campus, Sharon.
For primary bibliographic entry see Field 5C.
W89-00312

PERIPHYTON, BENTHIC INVERTEBRATES AND FISHES AS BIOLOGICAL INDICATORS OF WATER QUALITY IN THE EAST BRANCH BRANDYWINE CREEK,
Pennsylvania Dept. of Environmental Resources, Norristown.
For primary bibliographic entry see Field 5A.
W89-00314

SOFT BOTTOM FAUNA NEAR THE RIVER ELBE ESTUARY UNDER THE INFLUENCE OF SEWAGE SLUDGE. I. SEASONAL VARIATION OF SPECIES NUMBER, ABUNDANCE AND BIOMASS IN RELATION TO SEDIMENT STRUCTURE (DIE WEICHBODENFAUNA VOR DER ELBEMUENDUNG UNTER DEM EINFLUSS DER KLAERSCHLAMMVERKLAPPUNG. I. DIE SAISONALE VERAENDERUNG VON ARTEN- UND INDIVIDUENZAHL SOWIE BIOMASSE UNTER BERUECKSICHTIGUNG DER SEDIMENTSTRUCKTUR),
Zoologisches Inst. und Museum, Hamburg (Germany, F.R.).
For primary bibliographic entry see Field 5C.
W89-00316

MICROHABITAT USE BY AN ASSEMBLAGE OF CALIFORNIA STREAM FISHES: DEVELOPING CRITERIA FOR INSTREAM FLOW DETERMINATIONS,
California Univ., Davis. Dept. of Wildlife and Fisheries Biology.
For primary bibliographic entry see Field 6D.
W89-00319

APPLICATION AND TESTING OF AN INDEX OF BIOTIC INTEGRITY IN SMALL, COOL-WATER STREAMS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Fisheries and Wildlife Sciences.
P. M. Leonard, and D. J. Orth.
Transactions of the American Fisheries Society TAFSAI, Vol. 115, No. 3, p 401-414, May 1986. 3 fig, 8 tab, 70 ref.

Descriptors: *Monitoring, *Water pollution effects, *Biotic integrity, *Water quality, *Biomonitoring, Indexes, Streams, Ecosystems, Fish, Habitats, Degradation.

A recently proposed index of biotic integrity (IBI), which applies features of indigenous fish communities to assess watershed and stream quality, is based on the assumption that community features change consistently with stream degradation. The IBI was modified for and applied to small coolwater streams in the Appalachian Plateau region of West Virginia. Changes in fish community variables proposed for the IBI were tested in seven similar streams exhibiting a wide range of stream degradation due to sewage, mining, and urbanization. A consistent response with increasing stream degradation was found for the following variables: total number of species, proportion of individuals as creek chubs Semotilus atromaculatus, species richness and composition of darters (Percidae), number of fish in sample, and proportion of fish with disease or anomalies. Proportions of omnivores, insectivorous cyprinids, and herbivore-detritivores yielding inconsistent results due to confounding interactions with species tolerance, whereas alternative trophic metrics, the proportions of specialist insectivores and generalist feeders, produced consistent trends with increasing stream degradation. A modified IBI, based on six fish community attributes, exhibited close agreement with independent rankings of stream degradation. (Author's abstract)
W89-00323

DOES PH AFFECT FISH SPECIES RICHNESS WHEN LAKE AREA IS CONSIDERED,
Fish and Wildlife Service, Kearneysville, WV. Eastern Energy and Land Use Team.
P. J. Rago, and J. G. Wiener.
Transactions of the American Fisheries Society TAFSAI, Vol. 115, No. 3, p 438-447, May 1986. 2 fig, 5 tab, 66 ref.

Descriptors: *Hydrogen ion concentration, *Fish, *Lakes, *Species diversity, *Acidic water, Population dynamics, Statistical methods, Model studies, Chemical analysis.

Numerous surveys have shown that fish species richness (number of species) is positively correlated with lake pH. However, species richness of fish communities is also correlated with lake size, and low-pH lakes are often small. Thus, conclusions drawn from examination of fish community structure relative to spatial (among-lake) variation in pH have been limited by uncertainties regarding the confounded effects of lake area. Two statistical methods were used in the analysis of covariance and a nonparametric blocked comparison test, to remove effects of lake area and compare fish species richness in low-pH and high-pH lakes. Data from six previous surveys of water chemistry and fish communities in lakes of Ontario and northern Wisconsin were examined. Lakes with low pH (< or = 6.0) contained significantly fewer fish species than lakes with high pH (> 6.0) when the effect of lake area was considered. A simple probabilistic model showed that the ability to detect differences in species richness is low when lake areas and the pool of potential colonizing species are small. The blocked comparison test was recommended for separating the effects of lake area and pH on species richness and urge critical examination of inferences based on analyses of fish communities in small lakes. (Author's abstract)
W89-00324

RELATIONS BETWEEN HABITAT VARIABLES AND CHANNEL CATFISH POPULATIONS IN PRAIRIE STREAMS,
Oklahoma Cooperative Fishery Research Unit, Stillwater.
W. G. Layher, and O. E. Maughan.
Transactions of the American Fisheries Society TAFSAI, Vol. 114, No. 6, p 771-781, November 1985. 2 fig, 3 tab, 30 ref.

Descriptors: *Habitats, *Catfish, *Prairies, *Streams, *Kansas, Regression analysis, Runoff, Water temperature, Biomass, Model studies, Statistical models, Streamflow.

Standing stocks (kg/ha) of channel catfish Ictalurus punctatus were graphed against 19 abiotic variables measured for Kansas streams. The resulting habitat suitability curve for each variable allowed fish biomass to be normalized to index values (range, 0.0-1.0) that could be regressed linearly against the abiotic variables. Stepwise multiple-regression techniques isolated three variables (runoff, fraction of stream area consisting of runs, and water temperature) that accounted for nearly half the variability in channel catfish biomass. When the regression model derived from Kansas data was applied to an independent data set from Oklahoma, the correlation between predicted and observed standing stocks was highly significant, though low. Assigning suitability index values to the Oklahoma data set from the habitat suitability curves developed from Kansas data resulted in a significant model with more (often difficult) variables accounting for three-fourths of the biomass variability. The regression model must be fit separately to each data set; although it is locally useful, it has low predictive power across geographic regions. It does indicate (a) that habitat suitability curves are at least regionally consistent, and (b) that variations in stream biomass of channel catfish can be explained largely in abiotic terms. (Author's abstract)
W89-00325

PREDICTION OF RAINBOW TROUT EMBRYO SURVIVAL IN RELATION TO GROUNDWATER SEEPAGE AND PARTICLE SIZE OF SPAWNING SUBSTRATES,
Waterloo Univ. (Ontario). Dept. of Biology.
T. K. Sowden, and G. Power.
Transactions of the American Fisheries Society TAFSAI, Vol. 114, No. 6, p 804-812, November 1985. 3 fig, 3 tab, 51 ref. National Science and Engineering Research Council Grant A1728.

Descriptors: *Trout, *Embryos, *Spawning, *Groundwater, Streambeds, Stream fisheries, Dissolved oxygen, Model studies, Survival.

Several measures of the size composition of spawning substrates were used to describe the survival of preemergent embryos of rainbow trout Salmo gairdneri in a groundwater-fed streambed. Survival was not significantly related ($P > 0.05$) to the percentage of sediments smaller than 2.0 mm in diameter, the geometric-mean particle size, or fredle indices of substrate quality. However, survival strongly depended on the mean dissolved oxygen content and velocity of groundwater in redds. Dissolved oxygen concentrations were not related ($P > 0.05$) to measures of substrate size composition, and these variables accounted for only a limited proportion of the variance among redds in seepage velocities. These factors account for the lack of any significant association between survival and substrate size composition. The findings imply that embryo survival models based on substrate size composition may not be entirely suitable for assessing the quality of spawning beds in groundwater-fed streams. (Author's abstract)
W89-00326

DIURNAL DISTRIBUTION AND BEHAVIORAL RESPONSES OF FISHES TO EXTREME HYPOXIA IN AN AMAZON FLOODPLAIN LAKE,
Hamburg Univ. (Germany, F.R.). Inst. fuer Hydrobiologie und Fischereiwissenschaft.
U. Saint-Paul, and G. M. Soares.
Environmental Biology of Fishes, Vol. 20, No. 2, p 91-104, October 1987. 6 fig, 1 tab, 43 ref.

Descriptors: *Diurnal distribution, *Fish behavior, *Hypoxia, *Lakes, Respiration, Oxygen, Flood plains, Fish, Macrophytes, Chara, Aquatic plants.

Because of the need for surface access for aquatic surface respiration (ASR), fish density increases were demonstrated for the open water of a floodplain lake during severe hypoxia. This indicates an O2-induced diurnal pattern of horizontal migrations between the zone of macrophyte cover and open water. Supplemental experimental investigations seem to suggest that species such as characoids, Colossoma macropomum and Schizodon fasciatum, deviate from this pattern. During long periods of oxygen depletion, they return to the region of macrophyte growth and survive there without displaying the usual kind of ASR. Mortality studies in net cages exposed in natural water bodies confirmed that only these two species are able to survive severe hypoxia beneath macrophyte cover. The possibility of an O2-input through the root system of plants is discussed. The O2-concentration has a significant influence on the locomotory behavior and the frequency of opercular movement in characoids. There is significantly less locomotory activity beneath the macrophytes during periods of oxygen depletion among those species not forced to migrate than among those in the open water regions, where normal ASR behavior is possible. (Author's abstract)
W89-00331

MICROBIALLY MEDIATED MN(II) OXIDATION IN AN OLIGOTROPHIC ARCTIC LAKE,
Alaska Univ., Fairbanks. Inst. of Marine Science.
C. G. Johnston, and G. W. Kipphut.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 6, p 1440-1445, June 1988. 2 fig, 4 tab, 20 ref. NSF grant DPP8320544.

Descriptors: *Manganese, *Oxidation, *Microbial degradation, *Oligotrophic lakes, *Arctic, Cycling nutrients, Poisons, Azide, Limnology, Todik Lake, Lakes, Sodium azide, Seasonal variation, Alaska.

Rates of oxidation of Mn(II) were measured by an in situ incubation technique in the water column of Toolik Lake, Alaska. Measured rates were lower than those observed in other aquatic systems but were sufficient to oxidize all Mn(II) in the lake within a 3-month period. Measured rates compared favorably with rates estimated from a previous study of the geochemical cycling of Mn in Toolik Lake. The Mn(II) oxidation was largely microbially mediated, as indicated by inhibition of oxidation rates by sodium azide. Azide had been previously demonstrated to be a suitable microbial poison for studying Mn(II) oxidation in seawater. This study demonstrates that azide is also a suitable poison for freshwaters and that it inhibits microbial but not abiotic oxidation of Mn(II). Manganese(II) oxidation rates were similar during cold, under-ice conditions in early spring and during warmer summer conditions. This observation suggests that Mn(II) concentration, rather than temperature or oxygen concentration, is the most important factor regulating Mn(II) oxidation rates in Toolik Lake. (Author's abstract)
W89-00335

PHOTOEXCRETION AND FATE OF GLYCOLATE IN A HOT SPRING CYANOBACTERIAL MAT,
Montana State Univ., Bozeman. Dept. of Microbiology.
M. M. Bateson, and D. M. Ward.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 7, p 1738-1743, July 1988. 4 fig, 4 tab, 33 ref. NSF Grant BSR-8315279.

Descriptors: *Hot springs, *Food chains, *Cyanophyta, *Glycolate, *Photosynthetic bacteria, *Microbiological studies, Microorganisms, Photosynthesis, Metabolism, Yellowstone National Park, Heterotrophic microorganisms, Cycling nutrients, Carbon cycle, Carbon radioisotopes, Radioactive tracers, Photoexcretion, Alkaline water, Oxygen supersaturation.

Photosynthesis by Synechococcus lividus, the sole oxygenic phototroph inhabiting the surface of the 55 C cyanobacterial mat in Mushroom Spring, Yellowstone National Park, causes superoxic and alkaline conditions which promote glycolate photoexcretion. At O2 concentrations characteristic of the top 2 mm of mat during the day, up to 11.8% of NaH(14C)O3 fixed in light was excreted, and glycolate accounted for up to 58% of the excreted photosynthate. Glycolate was neither incorporated nor metabolized by S. lividus, but it was incorporated by filamentous microorganisms in the mat. Incubation of mat samples with NaH(14C)O3 resulted in labeling of both S. lividus and filaments, but the addition of nonradioactive glycolate increased the level of 14C in the aqueous phase and decreased the extent of labeling of filaments. This suggests that cross-feeding of glycolate from S. lividus to filamentous heterotrophs occurs and that underestimation of the extent of photoexcretion is probable. (Author's abstract)
W89-00342

MICROBIAL DEGRADATION OF XENOBIOTIC, AROMATIC POLLUTANTS IN HUMIC WATER,
Lund Univ. (Sweden). Dept. of Ecology.
For primary bibliographic entry see Field 5B.
W89-00344

EFFECTS OF TEMPERATURE AND STREAMFLOW ON TIME AND DURATION OF SPAWNING BY SMALLMOUTH BASS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Fisheries and Wildlife Sciences.
R. J. Graham, and D. J. Orth.
Transactions of the American Fisheries Society TAFSAI, Vol. 115, No. 5, p 693-702, September 1986. 2 fig, 5 tab, 23 ref.

Descriptors: *Instream flow, *Water temperature, *Streamflow, *Spawning, *Bass, New River, Virginia, West Virginia, Flooding, Seasonal variation, Ecology, Temporal distribution, Discriminant functions, Dam effects, Temperature effects, Prediction.

The influences of eight water temperature and three discharge variables on the time and duration of spawning by smallmouth bass Micropterus dolomieui were evaluated in three mainstem sections and two tributaries of the New River in Virginia and West Virginia. Stepwise discriminant analysis was used to assess the relative importance of each variable in distinguishing between days when spawning did and did not occur. Spawning occurred from late April through mid-July at mean daily water temperatures ranging from 12.5 to 23.5 C. Frequency distributions of spawning dates were nearly identical among study sites, as was the timing of hydrologic events. Spawning activities were interrupted by flooding in June and resumed when water levels were receding. Mean daily water temperature explained most of the variation among groups of daily stream conditions related to spawning activities. Discriminant functions developed from three temperature variables and one discharge variable correctly classified 72% of the days on which spawning did and did not occur. The functions should be useful in predicting smallmouth bass spawning times in other streams. (Author's abstract)
W89-00373

EFFECTS OF STREAM CLEANING ON JUVENILE COHO SALMON AND DOLLY VARDEN IN SOUTHEAST ALASKA,
Pacific Northwest Forest and Range Experiment Station, College, AK. Inst. of Northern Forestry.
C. A. Dolloff.
Transactions of the American Fisheries Society TAFSAI, Vol. 115, No. 5, p 743-755, September 1986. 9 fig, 4 tab, 26 ref.

Descriptors: *Lotic environment, *Fish migration, *Streams, *Salmon, *Dolly Varden, *Ecological effects, Fish populations, Population density, Logging, Debris, Alaska, Population dynamics, Aquatic habitats.

The effects are described of selective removal of woody debris on populations of juvenile coho salmon Oncorhynchus kisutch and Dolly Varden Salvelinus malma in two small streams on Prince of Wales Island, Alaska, during the summers of 1979-1981. These streams contained debris left when surrounding forests were clear-cut in the late 1960s. Debris smaller than 60 mm in diameter and larger debris not embedded in the stream channel were manually removed from half of the study reach on each stream in 1979 by state-of-the-art techniques. Immigration and emigration of fish from the study sections and intrastream movements were very limited after an initial period of population adjustment in the spring regardless of treatment. Population densities and production of both species were typically higher in sections where debris accumulations had not been removed. Production of age-0+ and age-1+ coho salmon and age-1+ and age-2+ Dolly Varden during the June-September period ranged from 0.70 to 2.22 g/sq m in the cleaned sections and from 0.84 to 2.10 g/sq m in the uncleaned sections. Carrying capacities for both species were lower in cleaned sections despite the use of selective techniques for removing woody debris. (Author's abstract)
W89-00374

FEEDING OF A FRESHWATER FLAGELLATE, BODO SALTANS, ON DIVERSE BACTERIA,
Southampton Univ. (England). Dept. of Biology.
G. C. Mitchell, J. H. Baker, and M. A. Sleigh.
Journal of Protozoology JPROAR, Vol. 35, No. 2, p 219-222, 1988. 2 fig, 2 tab, 22 ref.

Descriptors: *Flagellates, *Bacteria, *Food habits, Streams, Protozoa, Microbiological studies, Chalk streams, Animal behavior, Migration.

Bodo saltans was isolated from a chalk stream and fed with pure cultures of seven bacteria obtained from the same river. The flagellates were allowed to migrate into suspensions of either of two bacterial species in a T-maze at 20-22 C. There was a significant difference ($P < 0.01$) between the numbers of flagellates which migrated into suspensions

of different bacteria, which were subsequently arranged in an order of 'attractiveness' to the flagellate. Bodo saltans grew successfully in monoxenic suspensions of all seven bacterial strains, but more rapid growth occurred with non-flagellated than with flagellated bacteria; this may be because while feeding, B. saltans tends to associate with surfaces where non-flagellated bacteria may also congregate. The efficiency with which B. saltans is able to utilize different bacteria may be influenced by the motility or secretory activities of the bacteria. There was no incontrovertible evidence that B. saltans responds to specific bacterial attractants. (Author's abstract)
W89-00381

FEEDING AND SWIMMING BEHAVIOR IN GRAZING MICROZOOPLANKTON,
Pace Univ., Pleasantville, NY.
M. Levandowsky, J. Klafter, and B. S. White.
Journal of Protozoology JPROAR, Vol. 35, No. 2, p 243-246, 1988. 1 tab, 24 ref.

Descriptors: *Animal behavior, *Swimming, *Zooplankton, *Food habits, Microbiological studies, Model studies, Random-walk model, Mathematical models, Turbulent flow, Chemosensory responses.

A random-walk model of food-searching behavior is considered for the microzooplankton. It is suggested that in still waters a random walk of the conventional sort, modeled by a Wiener process, is less efficient than a Levy walk (a random walk whose excursions follow a Levy distribution) with Levy parameter < 2. For Levy parameter < 1, however, little advantage is gained by further reduction. In turbulent water, on the other hand, dispersion due to a random walk is dominated by the turbulent diffusion of the medium so that the Levy parameter appears to be less important. The effect of chemosensory responses is considered. It is suggested that these are most useful in still water, whereas in turbulent water their value would be less, and a non-specific filtering behavior might be more plausible. (Author's abstract)
W89-00382

DYNAMICS OF PROTISTAN CARBON AND NUTRIENT CYCLING,
Woods Hole Oceanographic Institution, MA. Dept. of Biology.
For primary bibliographic entry see Field 2L.
W89-00383

PHAGOTROPHIC PHOTOTROPHS: THE ECOLOGICAL SIGNIFICANCE OF MIXOTROPHY,
Wisconsin Univ.-Milwaukee. Dept. of Biological Sciences.
M. E. Boraas, K. W. Estep, P. W. Johnson, and J. M. Sieburth.
Journal of Protozoology JPROAR, Vol. 35, No. 2, p 249-252, 1988. 1 fig, 43 ref. Sea Grant R1MW-32, EPA Grant R-810871-OL-O and NSF Grants OCE-8121881 and OCE-8516614.

Descriptors: *Ecology, *Mixotrophs, *Food habits, *Algae, Photosynthesis, Aquatic environment, Ecosystems, Phagotroph, Cycling nutrients, Predation, Trophic level, Trace elements, Vitamins, Nutrients.

Protists that both photosynthesize and consume other cells (mixotrophs) have been repeatedly observed, both in culture and in natural samples. Despite this, little is known of their ecological significance in aquatic systems. There appear to be several strong advantages for phagotrophy by a photosynthetic unicell. The phagotroph can obtain organic carbon for energy in the absence of light, both below the photic zone and at night. Minerals, especially phosphorus in freshwaters and nitrogen in the sea, can be obtained in a concentrated form. Some phagotrophs may not be able to obtain essential trace growth factors, e.g. vitamins, by any other means. The acquisition of nutrients and growth factors may be particularly important in extreme oligotrophic environments. Since phagotrophy by photosynthetic organisms has many advantages, the details of the competitive interactions between mixotrophic and obligate phototrophs should prove interesting. The recent appreciation of apochlorotic protists in nutrient cycling and control of bacterial and protist populations makes the elucidation of the extent of algal predation an important topic for future research. (Lantz-PTT)
W89-00384

HABITAT USE OF TWO DARTER SPECIES IN GLOVER RIVER, OKLAHOMA,
Fish and Wildlife Service, Anchorage, AK. Alaska Regional Office.
R. N. Jones, and O. E. Maughan.
Transactions of the Kansas Academy of Science, Vol. 90, No. 3-4, p 147-149, 1987. 1 tab, 14 ref.

Descriptors: *Aquatic habitats, *Glover River, *Darters, *Oklahoma, Logperch, Channel darters, Water depth, Flow velocity, Population density, Fish, Substrates, River beds, Riffles, Pools, Seasonal variation.

Darters were collected by electroshocking a known area on a quarterly basis from 1978 to 1980. Logperch were captured most frequently in pools, although they were occasionally taken in deeper riffles and runs in spring. Captures were made at depths of 17 to 106 cm but fish occurred most frequently at depths $>$ or $=$ 40 cm. Relative density was highest at depths $>$ or $=$ 80 cm. Captures occurred in areas where velocities were 0 to 59 cm/sec but were most frequent where velocities $<$ or $=$ 19 cm/sec. A wide range of substrates were present at capture location but most occurred over rubble-boulder, boulder, and boulder-bedrock. Channel darters tended to be most common in pools and deep runs, but were also regularly taken in riffles in spring. Captures were at depths of 5 to 90 cm; relative densities were generally higher at depths of 20 to 79 cm. Water velocities at capture locations were 0 to 73 cm/sec but they occurred most frequently in water velocities of 20 to 59 cm/sec. Channel darters occurred over many substrates but most often over sand-gravel, gravel, gravel-rubble, and bedrock. Relative densities were highest over gravel substrates. Habitat use by these two species in Glover River was the same as has been reported for other streams. (Lantz-PTT)
W89-00396

MACROINVERTEBRATE POPULATIONS IN A THERMALLY IMPACTED RESERVOIR,
Daily Analytical Lab., Peoria, IL.
For primary bibliographic entry see Field 5C.
W89-00397

PIONEER COLONIZATION AND INTERACTION OF PHOTOSYNTHETIC AND HETEROTROPHIC MICROORGANISMS ON AN ARTIFICIAL SUBSTRATE OF POLYURETHANE FOAM IN E. J. BECK LAKE, ILLINOIS,
Northeastern Illinois Univ., Chicago. Dept. of Biology.
R. Piekarczyk, and E. McArdle.
Transactions of the Illinois Academy of Science TISAAH, Vol. 78, No. 1 and 2, p 81-86, 1985. 2 fig, 1 tab, 18 ref.

Descriptors: *Microorganisms, *Artificial substrates, , *E. J. Beck Lake, *Colonization, Ecosystems, Illinois, Algae, Photosynthesis, Species diversity, Biological studies, Protozoa, Heterotrophs, Ecology.

The accrual of pioneer microbial inhabitants on an artificial substrate of polyurethane foam in E. J. Beck Lake during a 22-day sampling period was an approximately linear event. Compared to the fast and sometimes fluctuating arrival of photosynthetic algae, the colonization by protozoa was slow and steady. However, there was greater diversity for the photosynthetic algae than for the heterotrophic protozoa. Artificial substrates harvested toward the end of the sampling period yielded more phylogenetically advanced organisms and perhaps signified a transition to a more complex stage in the colonization sequence. (Author's abstract)
W89-00398

EFFECT OF PH AND TOTAL ION CONCENTRATION ON GROWTH RATE OF CHIRONOMUS NR. MATURUS LARVAE (DIPTERA: CHIRONOMIDAE) FROM AN ACID STRIP-MINE LAKE,
Southern Illinois Univ. at Carbondale. Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W89-00399

EFFECTS OF SEASON AND SUBSTRATE ON AVAILABILITY OF DRIFT FOR FISH IN A SMALL WARMWATER STREAM,
Illinois Univ. at Urbana-Champaign. Dept. of Ecology, Ethology and Evolution.
P. L. Angermeier, and P. C. Carlson.
Transactions of the Illinois Academy of Science TISAAH, Vol. 78, No. 3 and 4, p 199-206, 1985. 2 fig, 31 ref.

Descriptors: *Seasonal variation, *Substrates, *Fish, *Aquatic drift, *Streams, Water temperature, Jordan Creek, Aquatic insects, Larvae, Invertebrates, Larvae, Silt, Streambeds, Sand, Stream improvement, Illinois, Crustaceans, Species diversity.

Midday drift samples were collected through summer and autumn from two reaches of Jordan Creek, a second-order stream in east-central Illinois. The two study reaches differed primarily in gradient and substrate characteristics, with silt-sand predominating in the low-gradient reach, and gravel-cobble predominating in the high-gradient reach. Aquatic insect larvae, especially dipterans, were the most abundant invertebrates in samples from the gravel-cobble reach, but were uncommon in drift from the silt-sand reach, which was composed mostly of small copepods and cladocerans. Invertebrate abundance and size declined markedly through the summer in both study reaches, then increased through autumn. Insect larvae were virtually absent from the silt-sand drift in October, but were always present in drift from the gravel-cobble reach. On the basis of invertebrate size and abundance, the gravel-cobble reach provided a more dependable food base for Jordan Creek fishes than did the silt-sand reach. Stream modifications that alter substrate composition may increase the severity of seasonal food shortages for fish, and contribute to declining diversities in stream fish assemblages of the Midwest. (Author's abstract)
W89-00400

LONG-TERM ECOLOGICAL RESEARCH ON ILLINOIS RIVERS,
Illinois State Water Survey, Champaign. Surface Water Section.
N. G. Bhowmik, J. R. Adams, R. V. Anderson, R. A. Cahill, and M. Demissie.
Transactions of the Illinois Academy of Science TISAAH, Vol. 78, No. 3 and 4, p 247-261, 1985. 6 fig, 14 ref. NSF Grant BSR81-14563.

Descriptors: *Ecology, *Illinois River, *Research, Management planning, Long-term planning, Ecosystems, Long-term Ecological Research, Model studies, Productivity, Plankton, Macrophytes, Stream discharge, Benthos.

The concepts and goals of the Long-Term Ecological Research (LTER) at the Illinois River sites. The 'Illinois River' or 'large rivers' sites are described with regard to their size, diversity, and dynamic ecosystems. THe large river LTER project includes four research components: (1) succession and perturbation, (2) water and sediment fluxes, (3) biotic system structure, and (4) ecosystem function. The research focus of the first several years is given for each component. Significant early findings are also described. These results are being used to develop an integrated model including a hydrologic-hydraulic component and a biological community component. The high productivity of these large rivers is described in terms of plankton, macrophytes, and benthic organisms. (Author's abstract)
W89-00401

DISTRIBUTION OF CHITINOLYTIC BACTERIA IN VARIOUS AQUATIC SYSTEMS: A COMPARATIVE STUDY,
Trinity Christian Coll., Palos Heights, IL.
S. A. Konings, R. J. Wolff, and G. D. Van Dyke.
Transactions of the Illinois Academy of Science TISAAH, Vol. 79, No. 3 and 4, p 283-287, 1986.

Descriptors: *Aquatic bacteria, *Aquatic environment, *Species diversity, *Chitin, Ecosystems, Dissolved oxygen, Organic carbon, Klebsiella, Proteus, Serratia, Pseudomonas, Comparative studies, Turbulence, Metabolism, Decomposing organic matter.

Chitin is a natural, abundant, resistant aminopolysaccharide. Samples taken from nine aquatic ecosystems (five lotic, four lentic, all in Illinois) indicate that chitinolytic bacteria seem to be most abundant in habitats with high levels of dissolved oxygen, high levels of total organic carbon, and agitation of the water. This correlates with the high levels of chitinolytic bacteria found in streams and may be due in part to soil humus in runoff. Bacteria identified as chitinolytic included species of Klebsiella, Proteus, Serratia, and Pseudomonas. Species of Klebsiella and Proteus have not previously been recorded as chitinolytic. (Author's abstract)
W89-00402

EXPERIENCES OF LONG-TERM DESTRATIFICATION IN A WATER SUPPLY IMPOUNDMENT IN CENTRAL ILLINOIS,
Illinois State Water Survey, Peoria. Water Quality Section.
For primary bibliographic entry see Field 5G.
W89-00403

DEVELOPMENT OF STREAMLINED BOG ISLANDS IN THE CONTINENTAL INTERIOR OF NORTH AMERICA,
Minnesota Univ., Minneapolis. Limnological Research Center.
P. H. Glaser.
Arctic and Alpine Research ATLPAV, Vol. 19, No. 4, p 402-413, November 1987. 8 fig, 70 ref.
Contracts: NASA/NA55-28740, DOE DE-AC02-79EV, DOE DE-AC02-80EV10-414, NSF Grants DEB-792214, DPP-82-05700 and DEB-8109901.

Descriptors: *Peat bogs, *Landforms, *Surface runoff, *Geomorphology, *Wetlands, *Bogs, Morphology, Catchment areas, Geology, Islands, Runoff, Surface water, Vegetation establishment.

Boreal peatlands within the interior of North America have developed vegetation landforms that simulate the shape of geologic landforms, such as islands and river channels. The genesis and development of these vegetation landforms can be inferred from spatial transitions from one landform pattern to another and from the quantitative analysis of their shapes in plain view. The spatial transitions indicate that the bog islands develop (1) downslope from flow obstructions in catchments that have irregular relief and (2) by the fragmentation of a large bog (> 20 sq km) by the development of water tracks in catchments that are nearly level. The dimensions of these bog islands correspond to a lemniscate loop or the streamlined airfoil that minimizes resistance to a flowing fluid. The bog islands, therefore, seem to be equilibrium forms that represent a stable adjustment to the alkalinity and volume of runoff in the water tracks. (Author's abstract)
W89-00434

ECOHYDROLOGICAL APPROACH TO FLORAL AND VEGETATIONAL PATTERNS IN ARCTIC LANDSCAPE ECOLOGY,
Rijksinstituut voor Natuurbeheer, Leersum (Netherlands).
J. G. de Molenaar.
Arctic and Alpine Research ATLPAV, Vol. 19, No. 4, p 414-424, November 1987. 5 fig, 1 tab, 48 ref.

Descriptors: *Ecology, *Hydrologic Regime, *Vegetation establishment, *Artic zone, *Ecohydrology, Model studies, Plant growth, Topography, Greenland, Moisture gradient, Ecosystems, Moisture profiles.

The behavior of water in space and time, governed by initial and independent state factors such as climate and topography, largely controls the spatial patterning of primary plant species and vegetation types. The ecologically relevant quantitative and qualitative characteristics of the water regime at a given locality depend largely on its position relative to its hydrological source-sink system. These characteristics influence plant life conditions within the site directly (e.g., moisture supply) and indirectly (e.g., nutrient supply, pH). This complex of relationships is contained in an ecohydrological approach developed in The Netherlands and adapted to arctic conditions present in central southeast Greenland. It is suggested that this approach may help to increase our understanding of the local to regional patterning in the plant cover and to recognize conditions of special interest and vulnerability. Therefore, it may assist in predicting the impact of both natural changes and human activities and in tracing general processes of succession and possibilities for conservation and regeneration. (Author's abstract)
W89-00435

EFFECTS OF DISTURBANCES ALONG HYDROELECTRICAL TRANSMISSION CORRIDORS THROUGH PEATLANDS IN NORTHERN MANITOBA, CANADA.
Rannsoknastofnun Landbunadarins, Reykjavik (Iceland).
For primary bibliographic entry see Field 4C.
W89-00436

INFLUENCE OF AN ARCTIC LARGE-LAKES SYSTEM ON MESOCLIMATE IN SOUTH-CENTRAL BAFFIN ISLAND, N.W.T., CANADA,
Windsor Univ. (Ontario). Great Lakes Inst.
J. D. Jacobs, and L. D. Grondin.
Arctic and Alpine Research ATLPAV, Vol. 20, No. 2, p 212-219, May 1988. 6 fig, 5 tab, 13 ref.

Descriptors: *Climatology, *Lakes, Reservoirs, *Arctic zone, *Meteorological data collections, *Air-water interfaces, *Water temperature, Hydrodynamics, Surface waters, Mesoclimate, Microclimatology, Heat budget.

Investigations in the interior lowlands of south-central Baffin Island have confirmed the existence there of a relatively warm, mesoscale summer climate compared to regional averages, an observation that is supported by the presence of certain low arctic plants beyond their previously reported limits. A system of two large lakes, their drainage basins, and tributaries is seen as a major factor responsible for these conditions. Measurements made at Burwash Bay, where the Amadkuak River enters Nettilling Lake, provide the basis for heat budget estimates in the summer period. An average daily heat input of 22 MJ/sq m/d to the surface of the bay results in a late-season average temperature of the water column that is close to the average daily air temperature for July, which was 11 C in 1985 and 9 C in 1986. It is concluded that this heat reservoir acts to maintain locally moderate temperatures during times of cold air intrusion in summer and to retard the seasonal cooling in fall and early winter. (Author's abstract)
W89-00437

EVAPORATION FROM MACKENZIE DELTA LAKES, N.W.T., CANADA,
National Hydrology Research Inst., Saskatoon (Saskatchewan).
For primary bibliographic entry see Field 2D.
W89-00438

EUTROPHICATION OF LAKES AND RESERVOIRS: A FRAMEWORK FOR MAKING MANAGEMENT DECISIONS,
Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 5C.
W89-00439

DISRUPTION OF THE NITROGEN CYCLE IN ACIDIFIED LAKES,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 5C.
W89-00451

LAKE DREDGING BOOSTS RECREATIONAL AND ESTHETIC ENVIRONMENTS,
Creve Coeur Dept. of Public Works, MO.
For primary bibliographic entry see Field 5G.
W89-00468

SPATIAL PATTERNS OF N FIXATION (ACETYLENE REDUCTION) ALONG ENVIRONMENTAL GRADIENTS IN A WARM-TEMPERATE ESTUARY,
Port Elizabeth Univ. (South Africa). Dept. of Botany.
For primary bibliographic entry see Field 2L.
W89-00475

BENTHIC CHAMBER FOR USE IN RIVERS: TESTING AGAINST OXYGEN MASS BALANCES,
Ministry of Works and Development, Hamilton (New Zealand). Water Quality Centre.
For primary bibliographic entry see Field 7B.
W89-00488

MIXING OF TEMPERATURE-STRATIFIED LAKES AND RESERVOIRS BY BUOYANT JETS,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
For primary bibliographic entry see Field 5G.
W89-00492

ECOLOGICAL AND SAPROBIOLOGICAL STATUS OF THE RHINE (DER OEKOLOGISCH-SAPROBIOLOGISCHE ZUSTAND DES RHEINS),
Bayer A.G., Leverkusen (Germany, F.R.). Umweltschutz/Analytik.
N. Caspers, and D. Jaeger.
Zeitschrift fuer Wasser und Abwasser-Forschung ZWABAQ, Vol. 21, No. 2, p 31-35, April 1988. 1 fig, 1 tab, 66 ref.

Descriptors: *Stream biota, *Water pollution effects, *Rhine, *Aquatic animals, *Water quality control, Fate of pollutants, Rivers, Ecosystems, Fish, Insects, Crustaceans, Population density, Effluents.

The Rhine is one of the best investigated rivers in central Europe from the point of view of its present-day biocoenosis and its faunal history over the past 100 years. In the 1960s and early 1970s the number and quality of species in the Rhine reached an all-time low, but these parameters have now stabilized at a relatively high level in spite of the many competing demands made on the water by various users. The water quality map produced by the LAWA (Laenderarbeitsgemeinschaft Wasser - Supraregional Working Group on Water) categorizes the Rhine as quality class II/III or II; it would be very difficult to improve on this classification in a flowing water of such dimensions. The incident at Sandoz on November 1, 1986 has not resulted in the destruction of the ecosystem as was at first feared. Official investigations using sophisticated sampling techniques have shown that groups of organisms which suffered severe initial damage (fish, insects, crustaceans) in urban Basle had once again reached normal population densities by the summer of 1987. The Sandoz incident must, however, remain a warning to all users to implement further rational steps towards cleaning up the effluents which they discharge into the waterways. In particular plant safety in industrial production facilities must be subjected to critical scrutiny. (Author's abstract)
W89-00498

MOTOR-BOAT-DERIVED VOLATILE ORGANIC COMPOUNDS (VOC) IN LAKE WATER,
Tuebingen Univ. (Germany, F.R.). Inst. fuer Chemische Pflanzenphysiologie.
For primary bibliographic entry see Field 5B.
W89-00499

INFLUENCE OF SELECTED ORGANIC COMPLEXING AGENTS ON THE SORPTION OF HEAVY METALS IN RIVER SEDIMENTS (EINFLUSS AUSGEWAEHLTER ORGANISCHER KOMPLEXBILDNER AUF DIE SORPTION VON SCHWERMETALLEN AN GEWAESSERSEDIMENTE),
Technische Univ. Hamburg-Harburg (Germany, F.R.). Arbeitsbereich Umweltschutztechnik.
For primary bibliographic entry see Field 5B.
W89-00501

TYPHA PRODUCTIVITY IN A TEXAS POND: IMPLICATIONS FOR ENERGY AND NUTRIENT DYNAMICS IN FRESHWATER WETLANDS,
Texas Univ. at Dallas, Richardson. Graduate Program in Environmental Sciences.
B. H. Hill.
Aquatic Botany AQBODS, Vol. 27, No. 4, p 385-394, May 1988. 1 fig, 2 tab, 31 ref.

Descriptors: *Cattails, *Limnology, *Primary productivity, *Wetlands, Aquatic plants, Plant growth, Biomass, Nutrients, Precipitation, Ponds, Statistical analysis, Regression analysis, Texas.

Above- and below-ground biomass of Typha angustifolia L. was sampled monthly for 18 months from a small Texas pond. Maximum above-ground biomass was 2559 + or - 284 g ash-free dry weight/sq m in 1983 and 2895 + or - 217 g ash-free dry weight/sq m in 1984. Peak below-ground biomass for these 2 years was 2506 + or - 278 g ash-free dry weight/sq m and 2314 + or - 226 g ash-free dry weight/sq m, respectively. Stepwise multiple linear regression analyses revealed that mean above-ground biomass accrual was related to duration of growing season, cumulative precipitation, cumulative degree days and/or cumulative pan evaporation. The same was not true for below-ground biomass increases. Analysis of covariance revealed that the rates of above-ground biomass production were not significantly different (F test, $p < 0.05$) between the 1983 and 1984 growing seasons. Below-ground biomass turnover times for 1983 and 1984 were 2.47 and 1.21 years, respectively. (Author's abstract)
W89-00524

STRUCTURE OF A POPULATION OF LOBELIA DORTMANNA L. ALONG A GRADIENT OF INCREASING DEPTH IN AN OLIGOTROPHIC LAKE,
Gdansk Univ. (Poland). Dept. of Plant Ecology and Nature Protection.
J. Szmeja.
Aquatic Botany AQBODS, Vol. 28, No. 1, p 1-13, June 1988. 6 fig, 24 ref.

Descriptors: *Aquatic plants, *Lakes, *Limnology, *Population dynamics, *Oligotrophic lakes, Water depth, Macrophytes, Plant population, Spatial distribution, Population density, Reproduction, Ecology.

The density, spatial structure, reproductive strategy and age of a population of Lobelia dortmanna L. (macrophyte, isoetid) were investigated in a transect consisting of 6000 squares of 0.1 x 0.1 m. Micro-scale cartography during SCUBA observations was used without disturbing the natural structure of the population. The area occupied by the population depended on fluctuations in water level in the lake (observations were made from 1977 to 1983) and on the intensity of certain ecological factors. The population structure altered directionally with increasing depth. The following points are discussed: (1) the area covered by the local population, its natality, density and spatial structure with respect to the intensity and nature of ecological conditions, (2) the directionality of changes in the population structure, (3) the influence on reproduction of the non-uniformity of habitat conditions and of the social position of individuals in a population, (4) 'boundary' effects and the pulsation of boundaries, (5) the periodic restriction in reproduction and its consequences. (See also W89-00526) (Author's abstract)
W89-00525

SEASONAL DEVELOPMENT OF LOBELIA DORTMANNA L. AND ANNUAL BALANCE OF ITS POPULATION SIZE IN AN OLIGOTROPHIC LAKE,
Gdansk Univ. (Poland). Dept. of Plant Ecology and Nature Protection.
J. Szmeja.
Aquatic Botany AQBODS, Vol. 28, No. 1, p 15-24, June 1988. 3 fig, 26 ref.

Descriptors: *Population dynamics, *Aquatic plants, *Lakes, *Limnology, Macrophytes, Plant populations, Plant growth, Plant morphology, Germination, Seeds, Pollen, Oligotrophic lakes, Seasonal variation, Poland.

The periodicity of phenological phenomena and the sequence of developmental phases in individuals of Lobelia dortmanna L. (Lobeliaceae, macrophyte, isoetid) were studied. Observations were made in an oligotrophic lake in northern Poland (southern edge of the range). The following were investigated: (1) germination capacity of seeds 63.1-97.3%; (2) ripening period of seeds (220-260 days) and their calorific value (6139 + or - 378 cal./mg) dry weight; (3) morphological changes during ontogenetic development; (4) means of reproduction of individuals and their over-wintering; (5) phenological development phases, including dates of flower-bud formation, flowering and fruiting; (6) participation of offspring in generative and vegetative reproduction in the population; (7) annual balance of numbers in the population; (8) biology of pollination, seed dispersal and the seedling appearance strategy in the population. (See also W89-00525) (Author's abstract)
W89-00526

DEMOGRAPHIC STUDY OF AERIAL SHOOTS OF CAREX ROSTRATA IN RELATION TO WATER LEVEL,
Uppsala Univ. (Sweden). Inst. of Ecological Botany.
A. B. C. Hultgren.
Aquatic Botany AQBODS, Vol. 30, No. 1/2, p 81-93, February 1988. 4 fig, 1 tab, 15 ref.

Descriptors: *Aquatic plants, *Lakes, *Limnology, *Population dynamics, Biomass, Reservoirs, Seasonal variation, Aquatic soils, Macrophytes, Plant populations,Flooding, Environmental effects.

Demographic studies of the aerial shoots of the clonal perennial Carex rostrata Stokes were made in central Sweden in (1) a lake used as a regulated reservoir, (2) a non-regulated lake, (3) a mire influenced by regulation and (4) a natural mire. Shoots were treated as units of a population. There was a wide fluctuation in shoot density between the summer and winter populations at all sites, with a rhythm of increasing emergence observed in spring and summer and a higher toll of deaths in autumn. There was a wide variation between years in maximum shoot density at shallow and medium depths in the reservoir but in the mire which had a small variation in water level the shoot density was fairly constant. If the water level is low in spring and early summer the number of new shoots is larger than in years with a high water level. Only a small percentage of the shoots reached a maximum life span of 3 years. Comparisons with other studies show an increased longevity from nemoral to subartic zones. (Author's abstract)
W89-00530

ANALYSIS AND ASSESSMENT OF WATER QUANTITIES IN LAKES OF CHINA, (IN CHINESE),
Academia Sinica, Nanjing (China). Inst. of Geography.
W. Hongdao.
Oceanologia et Limnologia Sinica OECOBX, Vol. 18, No. 1, p 12-21, January 1987. 1 fig, 8 tab, 8 ref. English summary.

Descriptors: *Lakes, *Limnology, *China, *Storage capacity, Capacity, Statistical analysis.

Water quantities of China's lakes are discussed. China is a country with a large number of lakes mainly scattered over five lake districts. Preliminary statistics show that China has about 2,300 lakes with an area larger than 1 sq km. The total area amounts to 71,787 sq km, covering about 0.8% of the total area of the whole country. By calculations, the storage capacity of lakes is 708,800 million cu m, in which the fresh water amounts to 226,100 million cu m. The water quantities of lakes are not evenly distributed in the regions. Their variation within a year and between years are great, requiring that attention should be paid to the rational utilization of water quantities of the lakes. (Author's abstract)
W89-00531

HYDROLOGICAL FEATURES OF POYANG LAKE, (IN CHINESE),
Hydrometerological Experiment Station of Poyang Lake, Xingzi (China).
Y. Zongxian, and Z. Juncai.
Oceanologia et Limnologia Sinica OECOBX, Vol. 18, No. 1, p 22-27, January 1987. 2 fig, 2 tab, 1 ref. English summary.

Descriptors: *Lakes, *Poyang Lake, *Hydrology, *Limnology, Flooding, Water level fluctuations, China.

Poyang Lake is in the north of Jiangxi Province, 115 deg 48 min to 116 deg 45 min E and 28 deg 23 min to 29 deg 45 min N. It receives the water from Ganjiang, Fuhe, Xinjiang, Raohe and Xiushui rivers which are all in Jiangxi Province, and discharges to Changjiang River from its southern bank. The trend in the frequency of high water levels is increasing. The cause of this phenomenon was analyzed. The morphology of the lake and its variation during the past decades are measured and calculated. The flood within one year was statistically generalized into two peak floods and three mechanisms for annual highest flood levels. The composition of the lake water was analyzed. (See also W89-00535 and W89-00540) (Author's abstract)
W89-00532

DETERMINATION OF GROSS-BETA RADIOACTIVITY IN WATER OF THE CHANGJIANG RIVER AND SEA WATER NEAR ITS ENTRANCE TO SEA, (IN CHINESE),
Academia Sinica, Qingdao (China). Inst. of Oceanology.
K. Xinglun, Y. Yi, and R. Guangfa.
Oceanologia et Limnologia Sinica OECOBX, Vol. 18, No. 2, p 151-155, March 1987. English summary.

Descriptors: *Radioactivity, *Rivers, *Seawater, *Chemical properties, Changjiang River, Regression analysis.

Gross-beta radioactivity was determined with the barium chloride ferriammonium sulfate method. The gross-beta radioactivity in water of the Changjiang River was lower than in sea water. It ranged from 0.88 to 1.40 pCi/L; its mean value was 1.13 pCi/L. Gross-beta radioactivity in sea water ranged from 1.73 to 3.32 pCi/L; its mean value was 2.23 pCi/L. The regression computation showed that in the area observed the correlation coefficient between gross-beta and the chlorinity was 0.916. The water of Changjiang River diluted the gross-beta concentration in the sea water. (Author's abstract)
W89-00534

HYDROLOGICAL FEATURES OF POYANG LAKE (II), (IN CHINESE),
Hydrometerological Experiment Station of Poyang Lake, Xingzi (China).
Y. Zongxian, and Z. Juncai.

Oceanologia et Limnologia Sinica OECOBX, Vol. 18, No. 2, p 208-214, March 1987. 7 fig, 3 tab, 1 ref. English summary.

Descriptors: *Poyang Lake *Lakes, *Path of Pollutants, *Limnology, *China, *Mathematical models, *Sediment transport, Flow, Hydrology, Gravity flow, Wave action, Aeolian deposits, Water temperature, Lake basins, Water quality, Chemical properties, China.

The flow of Poyang Lake is divided into three kinds of flow as follows: gravity flow, top-lifted flow, and backward flow. A mathematical model is put forward to reflect the relations of the wind with the wave and the climbing height of the waves found in Poyang Lake. The quantities of the suspended matter flowing into and out of the lake were calculated, and their variations with space and time given. The washing and depositing regimes are summarized. Although not much sand from the lake's basin flows into the lake, its influence on some parts of the lake is still serious. The contents of common chemical elements, and the variations of the temperature of the lake water with time, place, and depth were analyzed. The lake is polluted slightly, but the water quality of the lake is still in good condition. (See also W89-00532 and W89-00540) (Author's abstract)
W89-00535

APPLICATION OF THE PRINCIPLE OF LEAST SIGMA TO THE CHEMICAL MODEL OF NATURAL WATER, (IN CHINESE),
Chinese Academy of Environmental Sciences, Beijing.
H. Jihua, and W. Tingjian.
Oceanologia et Limnologia Sinica OECOBX, Vol. 18, No. 3, p 273-279, May 1987. 6 tab, 10 ref. English summary.

Descriptors: *Lakes, *Trace metals, *Chemical properties, *Mathematical analysis, Acidity, Bicarbonates, Model studies, Sodium, Potasisum, Magnesium, Sulfates, Chlorides, Carbonates.

Applying the classification of HSAB and the Principle of Least, the chemical models of major constituents (Na(+), K(+), Mg(2+), HCO3(-), CO3(2-), SO4(2-), Cl(-), etc.) in water bodies of different aqueous chemical types were developed. The differences of these models in various areas and the transformation of chemical models in the various evolutionary steps of lakes are discussed. A chemical model of 26 trace elements in waters was also studied and the dominant complexes of those elements were calculated. The results showed that metal ions of the soft acid and the intermediate acid exist mainly as Me-Cl; the hardest acid in the salt lake forms mainly Me-F complexes; the principal chemical speciation form in the sub-hard acid is free ion. In fresh water lakes, trace elements belonging to the hard acid exist mainly as free ions. (Author's abstract)
W89-00537

PROBING INTO THE COMPUTATION METHOD ON SEDIMENTARY AMOUNT OF POYANG LAKE, (IN CHINESE),
Jiangxi Traffic Inst., Nanchang (China).
C. Tongzhao.
Oceanologia et Limnologia Sinica OECOBX, Vol. 18, No. 4, p 320-327, July 1987. 3 fig, 3 tab, 5 ref. English summary.

Descriptors: *Poyang Lake, *Lakes, *Sedimentation, *China, *Differential equations, Silting, Sediment transport, Mathematical analysis.

Poyang Lake is a natural lake capable of comprehensive utilization. It has great economic value in flood prevention, shipping, irrigation, fishery, etc. In order to satisfy the demands of the national economy department, it was necessary to investigate sand sedimentation. The silt transport balance differential equation derived from the concept of the limiting sedimentary amount for the water passing through the lake was examined. Methods for solving the differential equations under four different conditions are presented. (See also W89-00532 and W89-00535) (Author's abstract)
W89-00540

STUDY OF MODERN VICISSITUDES OF THE JIANGHAN LAKE GROUP BY USING REMOTE SENSING TECHNIQUES,
Central China Teacher's Univ., Wuchang (China).
Z. Shanghui.
Oceanologia et Limnologia Sinica OECOBX, Vol. 18, No. 5, p 469-476, September 1987. 5 fig, 1 tab, 7 ref.

Descriptors: *Marshes, *Jianghan Lakes, *Lakes, *Remote sensing, Aquatic plants, Rice, Aquatic soils, Forecasting, China.

The historical process which produced the vicissitudes of the Jianghan Lake group is recorded clearly in remote sensing images. Therefore, the distribution of historical lakes (paleolakes) can be made to reappear to some degree and the lakes' future evolutionary trend can be forecasted. The foundations of the image interpretation of the paleolakes are: (1) the paleolakes have turned into single-cropping rice fields, whose integral spectrums of 'water' and 'soil' have specific spectral and image properties; (2) vanguard plants, wild rice and reed, are the important signs of the lake's transformation into marsh; (3) embankments encircling low lying paddy fields are evidence of the splitting and dismembering of the Jianghan Lake group. Variations in the amount or number of aquatic plants is the principal sign of lake transformation into marsh on the Jianghan plain. Other conditions being the same, the interrelationship of the deep water color (black), lush aquatic plants, and rapid transformation into marsh may be established and used to forecast the trend of the lake's evolution. The field test and the contrast test of the soil map, the land use map, the photomontage and the topographic maps in different periods show that remote sensing is an effective method for studying lake evolution. This study shows that the total number and area of the Jianghan Lake group have decreased greatly due to reclamation and cultivation, and the lakes remaining are being transformed into marsh. (Author's abstract)
W89-00542

ESTIMATE OF THE VARIABILITY IN BIOTRANSFORMATION KINETICS OF XENOBIOTICS IN NATURAL WATERS BY AUFWUCHS COMMUNITIES,
Environmental Research Lab., Athens, GA.
For primary bibliographic entry see Field 5B.
W89-00559

METHOD TO ASSESS PERIODIC RESPONSES OF AQUATIC MICROECOSYSTEMS TO PHOTOSYNTHETIC INHIBITION,
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
For primary bibliographic entry see Field 7B.
W89-00562

CORRELATION OF SOME ORGANIC POLLUTION FACTORS IN WATER SYSTEMS IN NORTHERN GREECE,
Thessaloniki Univ., Salonika (Greece). Lab. of Analytical Chemistry.
For primary bibliographic entry see Field 5B.
W89-00566

COMPARATIVE STUDY OF HEAVY METALS POLLUTION IN VARIOUS RIVERS AND LAKES OF NORTHERN GREECE,
Thessaloniki Univ., Salonika (Greece). Environmental Pollution Control Lab.
For primary bibliographic entry see Field 5B.
W89-00571

TROPHIC STATE GRADIENTS AND ZOOPLANKTON AND ZOOBENTHOS DISTRIBUTION IN A PO RIVER DELTA LAGOON,
Ferrara Univ. (Italy). Ist. di Zoologia.
For primary bibliographic entry see Field 2L.
W89-00580

EVALUATION OF AQUATIC ENVIRONMENTAL FATE OF 2,4,6-TRICHLOROPHENOL WITH A MATHEMATICAL MODEL,
Mitsubishi-Kasei Inst. of Toxicological and Environmental Sciences, Yokohama (Japan).
For primary bibliographic entry see Field 5B.
W89-00616

CONTRIBUTIONS OF HEAVY METALS FROM MUNICIPAL RUNOFF TO THE SEDIMENTS OF LAKE PONTCHARTRAIN, LOUISIANA,
New Orleans Univ., LA. Center for Bio-Organic Studies.
For primary bibliographic entry see Field 5B.
W89-00618

ANNUAL CYCLE OF FREE-FLOATING BACTERIA IN THE BOT RIVER ESTUARY,
Cape Town Univ. (South Africa). Dept. of Zoology.
For primary bibliographic entry see Field 2L.
W89-00658

ZOOPLANKTON AND SOME ENVIRONMENTAL CONDITIONS IN THE BOT RIVER ESTUARY,
Department of Nature and Environmental Conservation, Stellenbosch (South Africa). Jonkershoek Nature Conservation Station.
For primary bibliographic entry see Field 2L.
W89-00659

ECOLOGICAL ROLE OF THE RED-KNOBBED COOT, FULICA CRISTATA GMELIN, AT THE BOT RIVER ESTUARY, SOUTH AFRICA: A PRELIMINARY INVESTIGATION,
Cape Town Univ. (South Africa). Dept. of Zoology.
For primary bibliographic entry see Field 2L.
W89-00662

CA(+2)-STRESS, BIOLOGICAL RESPONSE AND PARTICLE AGGREGATION IN THE AQUATIC HABITAT,
Hamburg Univ. (Germany, F.R.). Geologisch-Palaeontologisches Inst. und Museum.
For primary bibliographic entry see Field 2K.
W89-00669

ALGAL STUDIES OF THE RIVER ELY, SOUTH WALES, U.K.: I. PHYTOPLANKTON,
University Coll., Cardiff (Wales). Dept. of Plant Science.
R. T. Esho, and K. Benson-Evans.
Nova Hedwigia NOHEAI, Vol. 40, No. 1-4, p 347-368, 1984. 11 fig, 2 tab, 43 ref.

Descriptors: *Algae, *Phytoplankton, *Ely River, *Flow rates, *Species composition, *Seasonal variation, *Temperature effects, Cyanophyta, Diatoms, Euglenophyta, Cryptophyta, Silicates, Wales, Organic matter, Water pollution.

The species composition and seasonal variations of the total phytoplankton and main algal phyla in the River Ely, South Wales were studied for the first time. Some environmental parameters were also studied. The algal species were dominated by the pennate diatoms. The total phytoplankton showed a definite seasonal fluctuation with a minimum generally recorded in winter and a maximum in spring and early summer. Temperature and flow rate seemed to have played a major role in such a fluctuation. The Bacillariophyta generally dominated the other phyla and reached their maxima in spring. These maxima coincided with the sharp decrease in silicate content at most stations, particularly in May. The Chlorophyta was second in dominance and showed no definite seasonal fluctuation except that they flourished during the warmer seasons. The Cyanophyta often were reduced in numbers or totally absent. They generally occurred during the warmer months as well as in January and February. High organic matter and temperature during the warmer months and high

organic content in January and February seemed favorable for algal growth. The Cryptophyta and the Euglenophyta were occasionally recorded and might have been derived from the epilithic and epipelic floras. (See also W89-00679) (Author's abstract)
W89-00678

ALGAL STUDIES OF THE RIVER ELY, SOUTH WALES, U.K.: II. EPILITHIC ALGAE,
University Coll., Cardiff (Wales). Dept. of Plant Science.
R. T. Esho, and K. Benson-Evans.
Nova Hedwigia NOHEAI, Vol. 40, No. 1-4, p 387-421, 1984. 13 fig, 4 tab, 43 ref.

Descriptors: *Algae, *Ely River, *Chlorophyll a, *Seasonal variation, *Benthos, *Diatoms, Chlorophyta, Myxobacteria, Wales.

The seasonal distribution of the epilithic algal populations of the River Ely, South Wales was studied. Chlorophyll-a content of the epilithic algae showed a major spring peak and a minimum in winter. Smaller late autumn peaks were also noted at some stations. The total benthic algae also showed a major spring peak and lower counts were obtained during the winter and summer months. Grazing of epilithic algae by the animal benthos possibly resulted in a decrease in the standing crops of the algal populations during summer. The diatoms dominated the epilithic algal flora and showed a spring peak. The chlorophyta came second in dominance and did not show any seasonal distribution. The most dominant algal species in the epilithic algal flora were Achnanthes lanceolata which was associated with A. linearis, Gomphonema parvulum, Navicula avenacea, N. cryptocephala, Nitzschia palea, Surirella ovata, Synedra ulna, Chlamydomonas spp. and Cladophora fracta. The saprobic indices 'S' of the epilithic algal flora showed that the non-tidal reaches of the River Ely were beta-mesosaprobic at all stations, except at station 5, where they were considered as alpha-mesosaprobic. (See also W89-00678) (Author's abstract)
W89-00679

SNAIL DISTRIBUTIONS IN LAKE ERIE: THE INFLUENCE OF ANOXIA IN THE SOUTHERN CENTRAL BASIN NEARSHORE ZONE,
Heidelberg Coll., Tiffin, OH. Water Quality Lab.
For primary bibliographic entry see Field 2A.
W89-00683

DEGRADATION AND FORMATION OF REFRACTORY DOM BY BACTERIA DURING SIMULTANEOUS GROWTH ON LABILE SUBSTRATES AND PERSISTENT LAKE WATER CONSTITUENTS,
Konstanz Univ. (Germany, F.R.). Limnological Inst.
A. Geller.
Schweizerische Zeitschrift fuer Hydrologie SZHYA6, Vol. 47, No. 1, p 27-44, December 1985. 7 fig, 1 tab, 26 ref.

Descriptors: *Biodegradation, *Limnology, *Aquatic bacteria, *Dissolved solids, *Organic carbon, *Lake water, *Limnology, *Aquatic bacteria, *Dissolved solids, *Organic carbon, *Biological properties, Molecular structure, *Chemical degradation, Degradation, Degradation products, Chromatography, Metabolism, Seasonal variation, Cosubstrates, Nutrition, Decomposing orgaic matter, Macromolecules, Chemical reactions, Chemical properties, Ecosystems.

Changes in molecular size distribution associated with degradation of refractory dissolved organic matter (DOM) macromolecules (apparent mol wt. > or = 1500) by 3 strains of bacteria were investigated by Sephadex G-15 gel permeation chromatography and dissolved organic carbon (DOC) analysis of the eluates. Macromolecules and bacteria were isolated from the same lake water sample, one taken in summer and one in winter. The decompositional changes of the DOM fraction were compared with respect to substance- and bacterial species-specific differences, and with respect to the action of photolysis and co-substrate supplementation. The metabolite patterns resulting from the simultaneous growth of the bacteria on the persistent DOM fraction and the labile co-substrate, glutamic acid were analyzed. The macromolecules differed in accessible components, and the bacteria degraded most effectively the DOM fraction of the parent lake water sample. Photolysis was the prerequisite for the reduction of the inaccessible bulk of the macromolecules. Glutamic acid enhanced the degradation of the macromolecules. The enhancement effect was impaired by the build up of waste products that balanced the losses of the DOM fraction. Three formation modes of refractory metabolites could be distinguished: formation of intensely UV-absorbing small-sized products that were poor in DOC during degradation of (1) the macromolecules of winter and (2) of glutamic acid, and formation of (3) apparent high molecular weight substances from glutamic acid in cultures containing the macromolecules of summer that probably results from a stable linkage between the small-sized metabolites of the amino acid and the DOM fraction. (Author's abstract)
W89-00691

DYNAMICS OF HYDRA POPULATIONS IN LAKE ZURICH, SWITZERLAND, AND LAKE MAGGIORE, ITALY,
Zurich Univ. (Switzerland). Zoological Museum.
G. Ribi, R. Tardent, P. Tardent, and C. Scascighini.
Schweizerische Zeitschrift fuer Hydrologie SZHYA6, Vol. 47, No. 1, p 45-56, December 1985. 2 fig, 4 tab, 42 ref.

Descriptors: *Hydra, *Aquatic animals, *Aquatic habitats, *Limnology, *Population dynamics, *Lakes, Seasonal variations, Biomass, Switzerland, Lake Zurich, Lake Magiore, Italy, Ciliates.

Hydra populations were sampled every two weeks for three years in Lake Zurich and for one year in Lake Maggiore. Hydra fusca was most abundant followed by H. circumcincta and H. attemata. The first two species showed strong seasonal fluctuations in abundance. Most of the reproduction occurred by budding. In all species, approximately one-third of the individuals carrying gametes was 1.6% in H. fusca and 13% in H. circumcincta in Lake Zurich. In Lake Maggiore, very few sexual individuals were found. The ciliate commensals Kerona polyporum and Trichodina pediculus were observed on approximately one-third of the individuals. (Author's abstract)
W89-00692

SEASONAL CHANGES OF THE PROFUNDAL MACROBENTHIC COMMUNITY IN A POLUTED LAKE,
Universita degli Studi 'La Sapienza', Rome (Italy).
For primary bibliographic entry see Field 5C.
W89-00693

EUTROPHICATION AND BENTHIC FAUNA OF THREE MOUNTAIN LAKES (EUTROPHISATION ET FAUNE BENTHIQUE DE TROIS LACS DE MONTAGNE),
Conservation de la Faune, Saint-Sulpice (Switzerland).
For primary bibliographic entry see Field 5C.
W89-00695

DRAINAGE BASIN CONTROL OF ACID LOADINGS TO TWO ADIRONDACK LAKES,
Clarkson Univ., Potsdam, NY. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W89-00710

COMPARISON OF ROBUST BAYES AND CLASSICAL ESTIMATORS FOR REGIONAL LAKE MODELS OF FISH RESPONSE TO ACIDIFICATION,
Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
For primary bibliographic entry see Field 5C.
W89-00713

ALKALINITY REGULATION IN SOFTWATER FLORIDA LAKES,
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
L. A. Baker, C. D. Pollman, and J. M. Eilers.
Water Resources Research WRERAO, Vol. 24, No. 7, p 1069-1082, July 1988. 8 fig, 6 tab, 45 ref. EPA Contract 68-03-3246.

Descriptors: *Water chemistry, *Acid rain, *Alkalinity, *Florida, Chemical properties, Cations, Atmospheric loadings, Groundwater, Hydrogen ion concentration, Path of pollutants, Lakes, Softwater lakes, Hydrologic data collection, Chlorides, Nitrates, Sulfates, Organic acids, Calcium, Potassium, Carbonates, Geohydrology.

Major ion chemistry data collected as part of the Environmental Protection Agency (EPA) Eastern Lake Survey was examined to evaluate the mechanisms and extent of alkalinity regulation in 37 undisturbed, softwater lakes in Florida. Comparison of major ion-Cl ratios in atmospheric deposition and in lakewater shows the reactions resulting in retention of sulfate and nitrate are the dominant sources of alkalinity; production of organic acids and ammonium retention are the major alkalinity-consuming processes. Based on average reactions, enrichment of major cations accounted for only 12% of net alkalinity generation in the study lakes. In general, calcium and potassium were depleted in low ANC (acid neutralizing capacity) lakes, presumably by in-lake sinks, and were enriched in most higher ANC lakes by groundwater inputs. Differences in alkalinity among these lakes reflect hydrologic factors and the proximity of clay and carbonate deposits to the lake bed. Overall, net alkalinity generation nearly balanced H(+) predicted from evaporative concentration of atmospheric acid inputs; this close balance suggests that the alkalinity status of these lakes is very sensitive to changes in atmospheric loadings and groundwater alkalinity inputs. (Author's abstract)
W89-00714

PREDICTING REGIONAL EPISODIC ACIDIFICATION OF SURFACE WATERS USING EMPIRICAL MODELS,
Northrop Services, Inc., Corvallis, OR. Environmental Research Lab.
For primary bibliographic entry see Field 5B.
W89-00719

EFFECTS OF ACIDIFICATION ON MERCURY METHYLATION, DEMETHYLATION, AND VOLATILIZATION IN SEDIMENTS FROM AN ACID-SUSCEPTIBLE LAKE,
Wisconsin Univ.-La Crosse. River Studies Center.
For primary bibliographic entry see Field 5B.
W89-00731

DECOMPOSITION IN AN OMBROTROPHIC BOG AND A MINEROTROPHIC FEN IN MINNESOTA,
Louisiana Tech Univ., Ruston. School of Forestry.
K. W. Farrish, and D. F. Grigal.
Soil Science SOSCAK, Vol. 145, No. 5, p 353-358, May 1988. 5 tab, 19 ref. NSF Grant DEB 7922142.

Descriptors: *Wetlands, *Peat bogs, *Fens, *Decomposition, *Minnesota, Mass loss, Carbon dioxide, Peat, Incubation, Aerobic conditions, Chemical analysis.

Using mass-loss and carbon dioxide-evolution techniques, the decomposition of peat in an ombrotrophic bog in northern Minnesota was evaluated. Mesh bags containing about 1 g of air-dried peat collected from several depths in the bog were placed at those same depths for a one-year incubation; containers made from solution-permeable, porous polyethylene tubing were used deeper in the peat profile. Mass loss from cellulose strips (3 x 8 cm) enclosed in mesh bags were used to compare potentials for decomposition between the bog and a nearby minerotrophic fen and among different depths within sites. Samples of drained, but undried, peat from different depths in the bog were incubated in the laboratory in an aerobic environ-

ment at 25 C; carbon dioxide evolved from the samples was determined by precipitation with barium chloride and titration with hydrochloric acid. Mass loss decreased with increasing depth in the peat due to environmental and substrate limitations. Mass-loss from cellulose was greater in the fen than in the bog. (Shidler-PTT)
W89-00742

LAKE TREATMENT WITH ALUM,
General Chemical Corp., Syracuse, NY.
For primary bibliographic entry see Field 5G.
W89-00745

VERTICAL DISTRIBUTION OF PHYTOPLANKTON IN A STRATIFIED LAKE (LAGO DOM HELVECIO, SOUTHEASTERN BRAZIL) WITH SPECIAL REFERENCE TO THE METALIMNION,
Universidade Federal de Sao Carlos (Brazil). Lab. of Limnology.
K. Hino, J. G. Tundisi, and C. S. Reynolds.
Japanese Journal of Limnology RIZAA, Vol. 47, No. 3, p 239-246, July 1986. 7 fig, 1 ta, 24 ref.

Descriptors: *Phytoplankton, *Vertical distribution, *Limnology, *Lakes, *Tropical regions, *Light intensity, *Nutrients, Stratified lakes, Chlorophyll a, Carbon assimilation, Metalimnion.

Possible causes of the deep maxima of several species of phytoplankton that occur in the metalimnion of Lake D. Helvecio, during a period of strong thermal stratification, at depths receiving very low intensities of incident radiation were investigated. The metalimnion was the site of almost half the total measured carbon fixation in the whole water column. The contribution of phytoplankton in the metalimnion to the formation of organic carbon in the whole water column represents 11.5%. The specific rate of photosynthesis (expressed per unit of chlorophyll) is severely limited by the low light levels. The pattern of vertical distribution is thought to confer some selective advantage to the survival and maintenance of the cyanobacteria found in the metalimnion since this species can selectively control its buoyancy. It may be that the cyanobacteria maintain vertical positions that alone satisfy both requirements (light, nutrients) for autotrophic growth. (Peters-PTT)
W89-00768

NITROGEN METABOLISM IN THE BRACKISH LAKE NAKANOUMI. III. NITRIFICATION-DENTRIFICATION IN LOW CONCENTRATION OF DISSOLVED OXYGEN, (IN JAPANESE),
Shimane Univ., Matsue (Japan). Faculty of Agriculture.
Y. Seike, K. Kondou, Y. Date, and Y. Ishida.
Japanese Journal of Limnology RIZAA, Vol. 47, No. 3, p 269-278, July 1986. English summary.

Descriptors: *Limnology, *Brackish water, *Denitrification, *Lakes, *Nitrification, Fate of pollutants, Nitrates, Dissolved oxygen, Lake Nakanoumi, Nitrogen removal, Lake sediments, Sediments.

Samples of water-sediment from the brackish Lake Nakanoumi, Japan, were incubated in the laboratory under several dissolved oxygen (DO) concentrations. The total inorganic nitrogen (TIN) concentrations decreased with increasing concentration of DO from 4 to 31%. Nitrification and nitrate reduction in water-sediment systems were simultaneously determined by the 15N dilution technique. The rates of nitrification, nitrate reduction and denitrification at 25 C were 9-15, 22-31 and 15-22 mgN/sq m/day, respectively. The summer TIN concentrations in the hypolimnion at the central part of Lake Nakanoumi substantially decreased during the period of 1979-1984. (Author's abstract)
W89-00769

SEASONAL CHANGE OF IRON AND MANGANESE IN LAKE FUKAMI-IKE: OCCURRENCE OF TURBID MANGANESE LAYER,
Nagoya Women's Univ. (Japan). Faculty of Home Economics.
A. Yagi, and I. Shimodaira.
Japanese Journal of Limnology RIZAA, Vol. 47, No. 3, p 279-289, July 1986.

Descriptors: *Limnology, *Eutrophic lakes, *Manganese, *Iron, *Seasonal distribution, Lakes, Dissolved iron, Lake Fukami, Turbidity, Boundary layers, Stagnant water.

A study was performed to clarify the dynamics of manganese and iron in a seasonally anoxic lake. Lake Fukami-ike, Japan, stratified from March to October, and the anoxic condition prevailed below 4-5 m depth. The occurrence of a turbid layer was found in the boundary of the oxic and anoxic layers from June to October. Its thickness ranged from 0.5-1.8 m. This layer was composed of particulate Mn. At the end of October, the turbid layer was composed of particulate Mn. At the end of October, the turbid layer gradually spread with the progress of circulation and finally disappeared. The dissolved oxygen concentration at the layer where the maximum of particulate Mn concentration in the water column appeared, was always about 0.5 mg/l. The release of manganous ion (Mn (2+)) in the boundary layer (4.0-4.5 m) and hypolimnion reached 0.1 and 1.5 mg/l, respectively. The results suggest that the major part of the Mn in the hypolimnion is supplied by release from surface sediment which was observed from the early stage of stagnation and continued until the autumnal overturn. The concentration of dissolved iron seemed to be controlled by the balance among the supply of allochthonous iron, the deposition or dissolution of particulate iron in the hypolimnion and the FeS fixation at the bottom. (Peters-PTT)
W89-00770

DISSOLVED ORGANIC CARBON AND MANGANESE IN THE BOUNDARY OF THE OXIC AND ANOXIC LAYERS IN LAKES FUKAMI-IKE AND SUIGETSU-KO,
Nagoya Women's Univ. (Japan). Faculty of Home Economics.
A. Yagi.
Japanese Journal of Limnology RIZAA, Vol. 47, No. 3, p 291-298, July 1986.

Descriptors: *Limnology, *Eutrophic lakes, *Anaerobic conditions, *Manganese, *Organic carbon, *Bacteria, Decomposition, Vertical distribution, Lakes, Lake Fukami, Lake Suigetsu.

The vertical distributions of dissolved organic carbon (DOC) and manganese were studied in Lakes Fukami-ike and Suigetsu-ko. A accumulation of particulate Mn and a decrease of DOC were found at the boundary of the oxic and anoxic layers in both lakes. It was confirmed that DOC absorption on the particulate Mn and pure chemical oxidation by the particulate Mn had made almost no contribution to DOC decrease. The reduction of the particulate Mn was associated with an increase in dissolved Mn and a decrease of DOC or glucose which was added in advance. It is suggested that the Mn reducing bacteria have only a partial role in DOC decomposition and that most of the DOC is consumed by other heterotrophic bacteria. (Peters-PTT)
W89-00771

STUDIES ON FORMATIONS AND CHANGES OF MICRO-STRATIFICATION IN BLACKISH WATER LAKE SHINJI, (IN JAPANESE),
Chugoku Regional Construction Bureau Officials Relief Association, Enya (Japan).
R. Sugai, S. Mutaguchi, and M. Matsumoto.
Japanese Journal of Limnology RIZAA, Vol. 47, No. 4, p 315-324, Oct. 1987.

Descriptors: *Stratification, *Anaerobic conditions, *Limnology, *Lake Shinji, *Saline water intrusion, Chemical properties, Phosphates, Dissolved oxygen, Bottom water, Ammonium, Chlorides, Anaerobic conditions, Vertical distribution, Ohashi River.

Vertical distribution of dissolved oxygen (DO), Cl(-), NH4(+), and PO4(3-) in the water layer adjacent to the bottom in Lake Shinji was investigated during summer-fall periods in 1981-1983. A water column sampler for micro-stratification was used to obtain near-bottom water at 10-20cm depth intervals from the bottom to 1.3 m. Salinity stratification in the deeper part of the lake allows the development of an anoxic condition and the accumulation of NH4(+) and PO4(3-). This suggests that anaerobic conditions enhance the release of phosphate from sediment. DO concentration in the near-bottom water in July 1982 as 0.5 mg/l from the bottom to 50-70 cm and the highest PO4(3-) concentration, 0.885 was 0.5 mg/l from the bottom to 50-70 cm and the highest PO4(3-) concentration, 0.885 mg/l (0-10 cm) and NH4(+)concentration, 1.267 mg/l were found in the anoxic layer. Total phosphorus increase in the upper zone from July through August in 1982 would correspond to the internal supply. The chlorinity distribution along the long axis in Lake Shinji in 1983 proved that salt water from the Ohashi River flowed into Lake Shinji and left a high saline layer in the deeper part of the lake. Gross release rates were estimated from mass changes of PO4(3-) and N4(+) in the stratified zone. The estimated gross release rate of PO4(3-) and NH4(+) was 11.6 mg/sq m/day, and 29.9 mg/sq m/day, respectively. When the chlorinity concentration in the upper zone was > 1,500 mg/l,the depth of high saline layer exceeded 40 cm. (Author's abstract)
W89-00772

UTILIZATION OF NITROGENOUS NUTRIENTS BY NATURAL PHYTOPLANKTON IN ENRICHED LAKE WATERS,
Office of the Czechoslovak Federal Premier, Prague.
N. Ishida, and O. Mitamura.
Japanese Journal of Limnology RIZAA, Vol. 47, No. 4, p 345-350, Oct. 1986.

Descriptors: *Limnology, *Eutrophic lakes, *Nutrients, *Phytoplankton, *Lakes, *Nitrogen compounds, Phosphorus, Nitrates, Ammonia, Urea, Chlorophyll a, Lake Biwa.

The utilization of nitrogenous compounds by freshwater phytoplankton was studied, after enrichments of nitrogen and phosphorus, in cultures of surface waters collected from three areas of different trophic grades (eutrophic, oligotrophic, and mesotrophic) in Lake Biwa. During the incubation period, in all experiments, the concentration of ammonia decreased first, urea decreased subsequently, and finally nitrate decreased. The assimilation of nitrate appeared when the ammonia concentration was almost undetectable in water. The assimilation of urea was also suppressed due to the high concentration of ammonia. This suggests the preference of phytoplankton for ammonia as a nitrogen source. The increasing rate of particulate nitrogen was almost equal to the decreasing rate of total nitrogenous nutrients in the water during the phytoplankton growing period. There were no appreciable differences in nutrient concentration or chlorophyll-a between the samples from the mesotrophic and oligotrophic areas. The growth rate of phytoplankton and the utilization rate of nutrients in the samples from the eutrophic area were much higher than in the other two cultures indicating that the influence of the nutrient enrichment on phytoplankton growth was much more effective. This suggests that nutrient loading into Lake Biwa from the watershed could enhance the phytoplankton growth even in the eutrophic area. (Peters-PTT)
W89-00773

DISTRIBUTION OF CADMIUM IN LAKE TOHYA,
Hokkaido Univ., Hakodate (Japan). Faculty of Fisheries.
I. Kudo, and K. Matsunaga.
Japanese Journal of Limnology RIZAA, Vol. 47, No. 4, p351-354, Oct. 1986.

Descriptors: *Lakes, *Limnology, *Path of pollutants, *Cadmium, *Nitrogen, Nutrients, Nitrates, Seasonal distribution, Lake Tohya.

The relationship between dissolved cadmium and dissolved total inorganic nitrogen was examined in Lake Tohya, Japan. More than 90% of the dissolved total inorganic nitrogen is in the nitrate form. The resultant equation is as follows: Cd (nM) = 0.025 N(microM) - 0.13. The slope (0.025) is in good agreement with that reported in seawater (0.024). This indicates that the removal of cadmium and the dissolved nitrogen from surface waters to deeper waters by biological assimilation and their regeneration in deeper waters would occur with the same ratio as in seawater. (Peters-PTT)
W89-00774

INTERCOMPARISON OF FOUR MIXED LAYER MODELS IN A SHALLOW INLAND SEA,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
M. J. McCormick, and G. A. Meadows.
Journal of Geophysical Research (C) JGRCEY, Vol. 93, No. 6, p 6774-6788, June 15, 1988. 12 fig, 4 tab, 64 ref.

Descriptors: *Lakes, *Model studies, *Shallow water, *Mixing, *Stratification, Water temperature, Surface water, Lake Erie, Mass transfer, Thermocline, Energy transfer, Comparison studies, Meteorological data collection.

Four mixed layer (ML) models were compared against an extensive water temperature data set collected in the central basin of Lake Erie during the summer of 1979. Results suggest that all four models are nearly equal in their ability to satisfactorily simulate surface water temperatures. However, if diurnal physical processes are of interest, then the model ability to simulate both the ML depth and the energy level associated with entrainment dh/dt becomes crucial. While three of the models, were satisfactory in simulating the ML depth, only two of them were satisfactory in matching the energy levels seen in the entrainment spectra of dh/dt. This agreement suggests that the shear velocity delta V entrainment scaling plays a critical role in the cycling of shallow depth mixed layers. (Author's abstract)
W89-00831

EFFECTS OF SULPHUR DEPOSITION ON LAKE-WATER CHEMISTRY IN ONTARIO, CANADA,
Ontario Ministry of the Environment, Dorchester. Dorset Research Center.
For primary bibliographic entry see Field 5B.
W89-00846

EFFECTS OF LIGHT AND TEMPERATURE ON PHOTOSYNTHESIS OF THE NUISANCE ALGA CLADOPHORA GLOMERATA (L.) KUTZ FROM GREEN BAY, LAKE MICHIGAN,
Wisconsin Univ., Madison. Dept. of Botany.
W. W. Lester, M. S. Adams, and A. M. Farmer.
New Phytologist NEPHAV, Vol. 109, No. 1, p 53-58, May 1988. 3 fig, 2 tab, 19 ref.

Descriptors: *Green Bay, *Algae, *Light quality, *Temperature effects, *Photosynthesis, *Limnology, Optical properties, Biomass, Seasonal variation, Lakes.

Seasonal measurements of light- and temperature-dependence of photosynthesis of the nuisance alga Cladophora glomerata (L.) Kutz were determined under laboratory conditions with algal samples collected from lower Green Bay, Lake Michigan. Photosynthesis rates were determined using oxygen difference in water circulated around the specimens. Photosynthesis reached light saturation at about 790 micro-moles photons/sq m/s (PAR) and had a temperature optimum between 28 and 31 C; maximum rates were 25-50 mg O2/dwt/h. These parameters varied seasonally with water temperatures. There was no evidence for a decline in photosynthetic rate with increasing temperature over the ranges used in this study. It is concluded that, in this instance, such an effect is not responsible for the mid-season decline of this species. Other effects, such as those of respiration, photorespiration and phenology may, therefore, be important. (Author's abstract)
W89-00848

FISH, FLEAS AND PHYTOPLANKTON,
University of East Anglia, Norwich (England). School of Biological Sciences.
For primary bibliographic entry see Field 5C.
W89-00851

DATA ANALYSIS OF WATER QUALITY TIME SERIES IN LAKE ERIE,
Waterloo Univ. (Ontario). Dept. of Systems Design Engineering.
For primary bibliographic entry see Field 7C.
W89-00866

TROPICAL EUTROPHIC LAKE MODELING AND PARAMETER DISCRIMINATION,
Princeton Univ., NJ. Dept. of Aerospace and Mechanical Sciences.
P. R. Jaffe.
Water Resources Bulletin WARBAQ, Vol. 24, No. 3, p 585-592, June 1988. 3 fig, 3 tab, 15 ref.

Descriptors: *Limnology, *Lakes, *Eutrophication, *Model studies, *Statistical analysis, *Eutrophication, *Water pollution effects, *Eutrophic lakes, Simulation analysis, Nutrient requirements, Algae, Dynamics, Water quality, Venezuela.

Water quality data collected between 1978 and 1981 in a highly eutropic lake in Northern Venezuela, Lake Valencia, were analyzed to detect spatial and temporal trends. Based on the results of the analyses, an appropriate nutrient-algae dynamics model was formulated. Because many parameters such as the algae concentration were constant over time, and the model is time dependent, the model had to be calibrated with the use of a large and structured trial-and-error calibration process. Through the calibration process, the most sensitive parameters of the model were identified, and are in order of importance: the chlorophyll-to-nitrogen ratio for algae, the algae settling velocity, the phosphorus release rate from the sediments, the chlorophyll-to-phosphorus ratio for algae, and the exchange coefficient in the upper layer of lake. Model simulations showed that a reduction in the nitrogen load to the lake as well as a reduction in the phosphorus load will decrease the algae population. These model simulations had a high degree of uncertainty associated with them, making additional sampling directed towards the measurement of the sensitive parameters desirable. (Author's abstract)
W89-00872

SOME BIOLOGICAL ASPECTS OF LIZA ABU (HECKEL) MUGILIDAE, IN AL-DAOODI DRAIN, (BAGHDAD, IRAQ),
Scientific Research Council, Baghdad (Iraq).
K. Y. Al-Yamour, S. B. Allouse, and A. R. Al-Jafary.
Journal of Environmental Science and Health (A) JESEDU, Vol. 23, No. 5, p 497-508, 1988. 5 fig, 2 tab, 8 ref.

Descriptors: *Aquatic animals, *Life history studies, *Ditches, *Mullet, *Iraq, *Fish, Reproduction, Brackish water, Growth rates, Growth, Water pollution effects.

The effects of grass carp on the destruction of nuisance growth of aquatic macrophytes in a drain were studied. Liza abu appeared in the catches from the drain and was the dominant species. Growth and reproduction of Liza abu were studied in water in a part of AL-Daoodi drain having salinity between 1-3%. The growth rate of L. abu in the drain showed a different pattern to that of their counterparts in the polluted Diyala River; growth rate in the river was higher and this may be attributed to enrichment of the river by sewage from Al-Rustamiyah treatment plant. Moreover, higher salinity in the drain (1.3%) may slow growth rate. Fecundity correlated best with length of fish and weight of ovary. (Vernooy-PTT)
W89-00890

SEASONAL PHYTOPLANKTON DEMOGRAPHIC PROCESSES AND EXPERIMENTS ON INTERSPECIFIC COMPETITION,
California Univ., Davis. Div. of Environmental Studies.
H. J. Carney, P. J. Richerson, C. R. Goldman, and R. C. Richards.
Ecology ECOLAR, Vol. 69, No. 3, p 664-678, June 1988. 12 fig, 2 tab, 76 ref.

Descriptors: *Phytoplankton, *Limnology, *Population dynamics, *Lake Tahoe, *Seasonal variation, *Thermal stratification, Diatoms, In situ tests, Nutrients, Epilimnion, Growth, Phosphates, Nitrates, Lighting, Nevada, Distribution patterns.

Population dynamics of Lake Tahoe phytoplankton species were studied during 1985. Four dominant diatoms were examined: Cyclotella glomerata, Cyclotella ocellata, Synedra amphicephala, and Synedra radians. The role of interspecific resource-based competition during spring and summer was tested in three ways: 1. species distribution patterns along the vertical gradient, 2. measurements of in situ growth and loss processes, and 3. transplants of assemblages between depths. All three tests indicated that resource-based competition was important. Species clearly segregated with thermal stratification and nutrient depletion in the epilimnion. C. glomerata peaked within the epilimnion (0-20m), S. radians became dominant in the deep chlorophyll maximum region (60-90 m), and the other species peaked at intermediate depths. Resource-limited growth was a dominant process during this time, and sinking and natural death were significant losses. Experimental transplants of assemblages between two depths (15 and 75 m) demonstrated competitive interactions in the phosphate-limited region near the surface, but there was no evidence of competition in the deeper light-limited region. This suggested asymmetrical competition along the vertical gradient. Primary productivity nutrient-enrichment bioassays and growth kinetic assays also indicated that phosphate and light limitation were important bases of species interactions. (Author's abstract)
W89-00906

PRIMARY PRODUCTION IN THE ORINOCO RIVER,
Colorado Univ. at Boulder. Dept. of Environmental, Population, and Organismic Biology.
W. M. Lewis.
Ecology ECOLAR, Vol. 69, No. 3, p 679-692, June 1988. 10 fig, 3 tab, 34 ref.

Descriptors: *Orinoco River, *Primary productivity, *Rivers, *Limnolgy, *Seasonal variations, *Phytoplankton, *Transparency, Tributaries, Streams, Biomass, Chlorophyll a, Flood plains, Algae, Sampling, Incubation, Irradiation, Dams, Discharge measurement, Venezuela.

Autotrophic carbon fixation was studied from 1982 to 1985 along a 500 km reach of the Orinoco River, Venezuela, and in three major tributaries. Among the tributaries, the annual mean gross primary production was highest for the Apure River, a whitewater river that drains from the Llanos region to the north of the Orinoco. Mean annual production was lower in the black water tributaries draining from the Guayana Shield to the south. In the Orinoco main stem, mean production varied among stations. Both in the main stem and the tributaries, production per unit volume and per unit area peaked during the period of low water. Seasonal variations at a given station were almost entirely explained by variations in the phytoplankton biomass per unit volume rather than by seasonal variations in transparency. However, differences in mean transparency among the tributaries partly explained differences in mean production per unit area: suppression of potential production by dissolved and suspended substances was 85% in whitewaters (Apure), 40% in blackwaters (Caura, Caroni), and intermediate in the Orinoco main stem. Autotroph biomass, as chlorophyll a, was highest for the Apure River, lowest for the blackwater tributaries, and intermediate for the Orinoco River. A mass-balance method was used in estimating the yield of phytoplankton biomass from the

floodplain to the river. The floodplain, although productive, conserves algal production, and in this respect functions as a closed system, even though it is physically an open system. (Author's abstract)
W89-00907

PEAT ACCUMULATION AND THE SUCCESS OF MARSH PLANTS,
Brown Univ., Providence, RI. Graduate Program in Ecology and Evolutionary Biology.
M. D. Bertness.
Ecology ECOLAR, Vol. 69, No. 3, p 703-713, June 1988. 5 fig, 2 tab, 34 ref.

Descriptors: *Salt marshes, *Peat, *Marsh plants, *Halophytes, *Spartina, *Nutrients, Littoral environment, Habitats, Nitrogen, Sediments, Rhode Island, Biomass, Interstitial water, Salinity, Chemical properties, Detritus.

To examine the influence of peat accumulation on the success of marsh plants, unvegetated substratum varying in peat density was transplanted over a tidal gradient in a New England salt marsh, and colonizatin of the plots was followed for three years. Manipulated plots were established in the tall and short form Spartina alterniflora zones and near the littoral border of the Spartina patens zone. Substratum type influenced plant colonizaiton of plots in each zone. In the tall and short form S. alterniflora zones, the vigor of S. alterniflora invading plots decreased with increasing peat density. In both of these zones, S. alterniflora production in experimental plots lacking peat exceeded even that in unmanipulated control plots, suggesting that natural peat accumulation in these habitats reduces plant production. Experimental plots in S. patens zone also were colonized as a function of peat density. All plots in the S. patens zone were heavily colonized by S. alterniflora , suggesting that S. alterniflora is normally excluded from this habitat by the presence of high marsh vegetation. S. alterniflora invasion of the S. patens zone plots, however, precluded assessing the influence of substratum type on the success of the grasses normally found in this habitat. A physical parameter inventory of the experimental plots indicated that plant growth in the plots was not correlated with many edaphic conditions believed to favor marsh plant growth. These data suggest that peat accumulation in marsh habitats may inhibit plant growth, lead to autogenic changes in plant performance, and contribute to within and between marsh variation in plant production. (Author's abstract)
W89-00909

SEDIMENTATION OF PARTICULATE MATERIAL IN TWO SHALLOW, LAND-LOCKED FJORDS IN WESTERN NORWAY,
Bergen Univ. (Norway). Inst. of Marine Biology.
For primary bibliographic entry see Field 2J.
W89-01008

BACTERIAL PRODUCTION IN FRESH AND SALTWATER ECOSYSTEMS: A CROSS-SYSTEM OVERVIEW,
Institute of Ecosystem Studies, Millbrook, NY.
J. J. Cole, S. Findlay, and M. L. Pace.
Marine Ecology Progress Series MESEDT, Vol. 43, No. 1/2, p 1-10, March 24, 1988. 5 fig, 3 tab, 64 ref. NSF Ecosystems Studies Program Grant BSR-8516897; Hudson River Foundation Grants 003/86A/012 and 016/86B/005.

Descriptors: *Bacteria, *Aquatic bacteria, *Productivity, *Aquatic environment, *Marine environment, Heterotrophic bacteria, Marine bacteria, Marine biology, Environment, Benthic environment, Microbiological studies, Organic matter, Biomass, Biotransformation, Sediments, Carbon, Organic carbon, Lakes, Chlorophyll A, Plankton, Zooplankton, Ecology, Reviews.

Data from 70 studies were reviewed in which estimates of production of heterotrophic bacterial biomass (bacterial production) were reported for fresh- and saltwater ecosystems. In sediments, bacterial production was significantly ($p < 0.001$), positively correlated to sediment organic C content. Systems which had high rates of benthic primary production (such as coral reefs) had rates of bacterial production greater than those predicted by sediment organic C content alone. In the photic zone of lakes and the ocean, bacterial production was significantly correlated with planktonic primary production, chlorophyll a, or numbers of planktonic bacteria. For all planktonic systems analyzed, bacterial production ranged from 0.4 to 150 micrograms C/l/d and averaged 20% (median 16.5%) of planktonic primary production. On an areal basis for the entire water column, bacterial production ranged from 118 to 2,439 mg/sq m/d and averaged 30% (median 27%) of water column primary production. Heterotrophic bacterial production is, thus, a large component of total secondary production and is roughly twice as large as the production of macrozooplankton for a given level of primary production. (Author's abstract)
W89-01034

THERMAL SIMULATION OF A LAKE WITH WINTER ICE COVER,
Western Australia Univ., Nedlands. Centre for Water Research.
J. C. Patterson, and P. F. Hamblin.
Limnology and Oceanography LIOCAH, Vol. 33, No. 3, p 323-338, May 1988. 9 fig, 1 tab, 32 ref. Environment Canada Contract 0SE18-00253.

Descriptors: *Lakes, *Model studies, *Thermodynamics, *Ice cover, *Mixing, *Thermal stratification, Stratification, Snow, Ice, Ice thickness, Limnology, Heating.

A one-dimensional thermodynamic model of a two-component ice and snow cover is added to an existing one-dimensional lake mixing model. Emphasis is placed on the thermodynamic coupling between the ice and mixing models, absent in previous models. The two-dimensional effects of partial ice cover are incorporated into this one-dimensional framework by using a minimum ice thickness. The model is applied to Lake Laberge, Yukon Territory, and to Babine Lake, British Columbia, for periods covering the formation and demise of full ice cover. The results of the model are compared to snow and ice measurements in the first case and to water column data during the spring period in the second. The comparisons are good, implying that the ice and snow model is performing satisfactorily and emphasizing the importance of the coupling between the ice and the underlying water. The successful simulation of the observed mixed layer under the ice, driven by convective stirring caused by short-wave heating below the temperature of maximum density, is an example of the ability of the model to provide physical insight into processes occurring in lakes. (Author's abstract)
W89-01044

MANGANESE OXIDATION IN PH AND O2 MICROENVIRONMENTS PRODUCED BY PHYTOPLANKTON,
Wisconsin Univ., Milwaukee. Center for Great Lakes Studies.
For primary bibliographic entry see Field 2K.
W89-01045

DISCRIMINATION BETWEEN ALGAE AND ARTIFICIAL PARTICLES BY FRESHWATER AND MARINE COPEPODS,
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.). Dept. of Ecophysiology.
W. R. DeMott.
Limnology and Oceanography LIOCAH, Vol. 33, No. 3, p 397-408, May 1988. 4 fig, 4 tab, 46 ref.

Descriptors: *Algae, *Particulate matter, *Animal behavior, *Copepods, *Food habits, *Zooplankton, Behavior, Crustaceans, Chlamydomonas, Chlorophyta, Aquatic animals, Plankton, Daphnia, Marine biology.

Chemically mediated food selection was studied with combinations of living algae and algal-flavored and untreated polystyrene spheres. The freshwater calanoid Eudiaptomus exhibited a strong preference for flavored spheres over untreated spheres when algae were scarce, but ingested few spheres of either type when algae were abundant. Experiments using a 'zooplankton sandwich technique' revealed a distinct ranking of preference: 6-micron Chlamydomonas > 6-micron Chlamydomonas-flavored spheres > 6-micron untreated spheres. Consistent with foraging theory, Eudiaptomus very strongly selected algae over flavored spheres when algae were abundant, but was less selective when algae were scarce. Sandwich experiments revealed differences in selectivity among individuals and between species of marine and freshwater zooplankton. In experiments with 12-micron algae and untreated 12-micron spheres, Eudiaptomus was highly selective, ingesting about 1,000 x more algae than spheres, whereas the cladocerans Daphnia and Sida fed nonselectively. The marine copepod Temora longicornis was less selective than Pseudocalanus sp., and both marine copepods were less selective than Eudiaptomus. These complex foraging patterns emphasize the need for carefully designed experiments with mixtures of natural particles of differing nutritional quality. (Author's abstract)
W89-01047

SPATIAL PATCHINESS IN THE LACUSTRINE SEDIMENTARY ENVIRONMENT,
Montreal Univ. (Quebec). Dept. of Biological Sciences.
J. A. Downing, and L. C. Rath.
Limnology and Oceanography LIOCAH, Vol. 33, No. 3, p 447-458, May 1988. 1 fig, 5 tab, 72 ref.

Descriptors: *Limnology, *Lakes, *Sediments, *Lake sediments, *Organic matter, *Pigments, *Phosphorus, Distribution, Regression analysis, Spatial distribution, Sampling, Benthos, Benthic fauna, Fauna, Aquatic animals, Water currents.

Spatial patchiness of sediment characteristics in central, bathymetrically uniform sites in eight lakes was examined by comparison of within- and among-core variation in water, organic matter, pigment, and phosphorus concentrations. Sampling sites were chosen to avoid known sources of sediment heterogeneity. Regression analysis of within-core and among-core variance on mean sediment characteristics was used to examine sampling exigencies. Comparisons of microscale and analytical variation with variation in sediment characteristics among core samples, within sites, showed significant sediment heterogeneity in > 62% of the comparisons. All sediment characteristics and all sampling sites showed some significant heterogeneity. The variance in sediment characteristics among core samples, within sites, was from 2 to 320 times greater than analytical or microscale variation. Spatial heterogeneity might result from aggregated benthic animals, slow currents, or small-scale variations in bottom profile. (Author's abstract)
W89-01048

MYXOCOCCAL PREDATION ON CYANOBACTERIAL POPULATIONS: NUTRIENT EFFECTS,
Toledo Univ., OH. Dept. of Biology.
P. C. Fraleigh, and J. C. Burnham.
Limnology and Oceanography LIOCAH, Vol. 33, No. 3, p 476-483, May 1988. 6 fig, 18 ref. NOAA National Sea Grant Program Office Grant NA84AA-D-00079; Ohio Sea Grant Project Grant R/ER-4.

Descriptors: *Bacteria, *Myxobacteria, *Cyanophyta, *Algae, *Eutrophication,, *Lakes, Lake Erie, Nostoc, Culture media, Nutrients, Microbiological studies, Predation, Culturing techniques, Water quality management, Limnology.

Myxococcus fulvus BGO2, a cyanobacteriolytic bacterium, reduced densities of the cyanobacteria Nostoc muscorum and Phormidium luridum in six inorganic media and in filtered water from Lake Erie when inoculated to give initial myxococcal densities of 5 x 10 to the 6th power cells/ml. When initial myxococcal densities were lower, the reduction in Nostoc density was delayed in a nutrient-rich medium and did not occur in a nutrient-poor medium. These laboratory results suggest that the

absence of myxobacteria in cyanobacterial blooms and the absence of cyanobacterial population control by related lytic bacteria, found in natural blooms, may be due, in part, to insufficient inorganic nutrient fertility to support growth of lytic bacterial populations to densities necessary to cause significant cell lysis in host populations. (Author's abstract)
W89-01050

STREAMFLOW REGULATION AND FISH COMMUNITY STRUCTURE,
Massachusetts Univ., Amherst. Dept. of Forestry and Wildlife Management.
For primary bibliographic entry see Field 4A.
W89-01053

TRACE METAL GEOCHEMISTRY OF PORE WATER BRINES FROM TWO HYPERSALINE LAKES,
New Hampshire Univ., Durham. Inst. for the Study of Earth, Oceans and Space.
For primary bibliographic entry see Field 2K.
W89-01079

HYDROGEN ION CONCENTRATION AND ALKALINITY OF RESERVOIR WATER IN THE SIERRA NEVADA, CALIFORNIA, AND CORRELATIONS WITH AIR POLLUTANTS,
California Univ., Berkeley. Dept. of Plant and Soil Biology.
For primary bibliographic entry see Field 5B.
W89-01165

TOXICITY OF ALKYLLEAD SALTS TO ANAEROBIC NITROGEN TRANSFORMATIONS IN SEDIMENT,
Macdonald Coll., Ste. Anne de Bellevue (Quebec). Dept. of Food Science and Agricultural Chemistry.
For primary bibliographic entry see Field 5C.
W89-01167

ECOLOGY OF FRESHWATER GASTROPODS IN THE CENTRAL CANADIAN REGION,
Winnipeg Univ. (Manitoba). Dept. of Biology.
E. Pip.
Nautilus (The) NUTLA5, VOl. 100, No. 2, p 56-66, April 30 1986. 7 tab, 17 ref.

Descriptors: *Ecology, *Gastropods, *Canada, *Macrophytes, *Aquatic habitats, Distribution, Aquatic populations, Species diversity, Water chemistry, Physiological ecology, Sediments, Dissolved solids, Spatial variation.

The ecology of freshwater gastropods was surveyed at more than 400 permanent aquatic habitats located within the area bounded by 47 and 54 degrees North and 94 and 106 degrees West from 1972 to 1984. Parameters examined were water body type, sediment type, gastropod community diversity, submerged macrophyte diversity, surface water pH, total dissolved solids, total alkalinity, chloride, sulfate, nitrate/nitrite and soluble reactive phosphorus. Many species showed distributions with respect to these parameters that differed from the total site sampling distributions. Gastropods in the study areas appeared to form a continuum according to habitat type, with Stagnicola palustris, Physa jennessi and Fossaria modicella at the higher extremes of water chemistry, and S. reflexa, Bulimnea megasoma, Marstonia decepta and Helisoma campanulatum at the lower end of the scale. Species able to tolerate high dissolved inorganic values also showed broad tolerance ranges for these parameters. Regional variation in tolerance ranges may be a complex function of adaptation combined with the inter-relationships between various aspects of habitats themselves. (Author's abstract)
W89-01183

STUDIES ON EPILITHIC AND EPIPHYTIC DIATOMS IN A CHALKSTREAM: COMPARATIVE ESTIMATES OF CHLOROPHYLL A AND ITS DERIVATIVES,
Freshwater Biological Association, Wareham (England). River Lab.
A. F. H. Marker, H. A. Hopgood, and C. F. Randall.
British Phycological Journal BPHJAA, Vol. 21, No. 2, p 171-182, June 1986. 7 fig, 3 tab, 36 ref.

Descriptors: *Diatoms, *Chlorophyll a, *Streams, *Epiphytes, Growth, Seasonal variation, Pigments, Suspended solids, Aquatic drift, England, River Frome, Thin layer chromatography.

The nutrient-rich chalk streams of southern England are characterized by extensive spring growths of epilithic and epiphytic diatoms. Diatom growth, reflected by the suspended solids in the River Frome, was monitored from late winter to midsummer by estimating chlorophyll a and its most significant pigmented degradation products. During 1985, chlorophyll a concentration was lowest in winter and was highest at the end of April. Pheopigments were highest in winter and lowest in midsummer. Separations by thin-layer chromatography indicated that chlorophyll a dominated the pigments from mid-April to mid-May. During winter, pheophytin a was the most significant breakdown product. In summer, the relative importance of pheophorbide a increased while the pheophytin a decreased, possibly reflecting greater grazing activity. Magnesium-containing breakdown products (chlorophyllide a, etc) never accounted for more than a small percentage of the total chlorophyll pigments, even during the decline of the diatom population. The results suggest that in late spring, live cells rather than dead cells, are being lost downstream in the suspended solids or into the sediment. (Author's abstract)
W89-01186

RELEASE OF MICRO-ALGAL PHOTOSYNTHATE AND ASSOCIATED BACTERIAL UPTAKE AND HETEROTROPHIC GROWTH,
University Coll. of Wales, Aberystwyth. Dept. of Botany and Microbiology.
A. K. Jones, and R. C. Cannon.
British Phycological Journal BPHJAA, Vol. 21, No. 4, p 341-358, December 1986. 2 tab, 129 ref.

Descriptors: *Algae, *Organic carbon, *Bacteria, *Algal growth, Organic matter, Heterotrophic bacteria, Energy transfer, Food chains, Ecosystems, Photosynthesis, Light, Carbon dioxide.

The origin of extracellular organic substances found in algal cultures. According to the current literature, it is generally accepted that healthy growing algae release a portion of the carbon they fix in photosynthesis as dissolved extracellular products. The extent of this release is variable, being affected by such factors as photon flux density, carbon dioxide concentration and nutrient stress. Heterotrophic bacteria may use the organic matter released by algae. It is probable that both the extent of such use and the nature of the bacterial flora are variable. If, as suggested in the literature, at least half of marine primary production passes through the planktonic microheterotrophs and if microbial secondary production may be comparable to that of herbivorous zooplankton and large compared with that of autotrophs, then present concepts of aquatic food webs will have to be revised. (Miller-PTT)
W89-01187

PHYTOPLANKTON AND REVERSED EUTROPHICATION IN LAKE MALAREN, CENTRAL SWEDEN, 1965-1983,
National Swedish Environmental Protection Board, Uppsala (Sweden). Environmental Quality Lab.
For primary bibliographic entry see Field 5G.
W89-01188

STATE OF THE ICHTHYOFAUNA IN ISTRINSK RESERVOIR SINCE ITS CONVERSION INTO A RECREATIONAL WATER,
Vserossiiskii Nauchno-Issledovatel'skii Inst. Prudovogo Rybnogo Khozyaistva, Konakovo (USSR).
S. S. Mosiyash.
Journal of Ichthyology JITHA2, Vol. 24, No. 6, p 131-138, 1984. 4 tab, 22 ref.

Descriptors: *Istrins Reservoir, *Population dynamics, *Fisheris, Reservoirs, Fish, Fish stocking, Statistical methods, Species composition, Recreation demand, Bream, Ichthyofauna, Soviet Union, Fishing.

The abundance of bream, Abramus brama, in Istrinsk Reservoir (Moscow district) is estimated and the extent of its exploitation by anglers is investigated. A total of 695 catches were analyzed in 1980-1981 and evaluated for size and species composition. To assess the bream stocks, the largest in the reservoir, the biostatistic method of P. V. Tyurin was applied according to the determination of the 'normal' curves of survival and rates of natural mortality. Arguments are presented in favor of the regulation of bream fishing in the reservoir with a view to the fuller use of fishing stocks and the improvement of the ichthyofauna composition. It is suggested that the numbers of anler visits not be increased to protect the fish stocks and to avoid additional pollution. (Miller-PTT)
W89-01191

CHANGES IN THE ECOSYSTEM OF THE AZOV SEA IN RELATION TO ECONOMIC DEVELOPMENT IN THE BASIN,
Azovskii Nauchno-Issledovatel'skii Inst. Rybnogo Khozyaistva, Rostov-na-Donu (USSR).
For primary bibliographic entry see Field 6G.
W89-01192

POSSIBILITY OF USING RADIOACTIVELY POLLUTED WATERBODIES FOR FISH CULTURE,
Akademiya Nauk SSSR, Moscow. Inst. of General Genetics.
For primary bibliographic entry see Field 3C.
W89-01193

FECUNDITY DYNAMICS OF KHRAMULYA, VARICORHINUS CAPOETA SEVANGI, IN RELATION TO THE CHANGING ENVIRONMENT OF LAKE SEVAN,
Akademiya Nauk Armyanskoi SSR, Sevan. Hydrobiological Station.
B. K. Gabrielyan.
Journal of Ichthyology JITHA2, Vol. 26, No. 6, p 134-140, 1986. 4 tab, 25 ref. Originally published in Voprosy Ikhtiologii, No. 5, 1986, p 814-819.

Descriptors: *Lake Sevan, *Growth, *Fish, *Fish eggs, Fish food, Lakes, Khramulya, Fish establishment, Reproduction, Correlation analysis.

Some aspects of reproduction biology of khramulya, Varicorhinus capoeta sevangi, were studied in light of the complex processes taking place in Lake Sevan in recent years. Lowered water levels have directly and indirectly reduced the food supply, growth rate and fecundity of fishes. The absolute and relative fecundity, size and weight of eggs and association of these parameters with the length, weight and age of females were studied. The calculation of correlation coefficients between individual absolute fecundity and different biological parameters, such as body weight, length and age, showed that the mean fecundity of Sevan Lake khramulya is highly correlated with body weight and to a lesser extent with body length and age. The lower correlation coefficient between individual absolute fecundity and body weight of females indicates an increase in the variability of these parameters which, with a slight reduction in the weight and diameter of mature eggs, suggests a definite deterioration of food availability. The data lead to the conclusion that the changes in the fecundity of Sevan Lake khramulya indicate a definite disturbance in the stability of conditions of its reproduction and feeding. (Miller-PTT)
W89-01194

SIZE STRUCTURE OF PLANKTONIC CRUSTACEANS IN A DIMICTIC LAKE ON THE CA-

NADIAN SHIELD (STRUCTURE EN TAILLE DES CRUSTACES PLANCTONIQUES D'UN LAC DIMICTIQUE DU BOUCLIER CANADIEN),
Montreal Univ. (Quebec). Dept. of Biological Sciences.
L. Martin, and B. Pinel-Alloul.
Canadian Journal of Zoology CJZOAG, Vol. 66, No. 7, p 1570-1577, July 1988. 4 fig, 2 tab, 37 ref. Conseil de Recherches en Sciences Naturelles et en Genie du Canada Subvention A02251 and Ministere de l'Education du Quebec Equipe EQ 0467. English summary.

Descriptors: *Lakes, *Population dynamics, *Zooplankton, *Crustaceans, *Limnology, *Dimictic lakes, *Canada, Canadian Shield, Biological samples, Quebec, Seasonal variation, Statistical analysis, Annual distribution, Larval growth stage, Frequency analysis, Food chains.

From May 1981 to July 1982, 28 zooplankton samples were taken from the pelagic zone of Lake Cromwell, Quebec. Seasonal variation in the size structure of the planktonic crustacean community was studied using three different multidimensional analyses: intermediate linkage clustering, principal coordinate analysis, and chronological clustering. The results of these analyses showed the existence of distinct patterns in the size distribution of planktonic crustaceans during the annual cycle. During winter, the community was dominated by intermediate-sized organisms (0.51-0.60 mm), and by a few of larger size (0.96 mm). In springtime, nauplii appeared, and the larger size classes were reduced, giving the size spectra a characteristic shape. Small organisms (0.06-0.22 mm) dominated the population throughout the summer. The fall season was characterized by the opposite observation: small organisms slowly decreased in number while the intermediate classes (0.51-0.60 mm) increased in number to reach their peak in winter. These size/frequency patterns may be related to varying food levels and composition throughout the year. (Author's abstract)
W89-01231

LAKE RESPONSE MODELING USING BIOLOGICALLY AVAILABLE PHOSPHORUS,
For primary bibliographic entry see Field 5C.
W89-01236

SAMPLING STRATEGIES AND ASSOCIATED ERRORS IN ESTIMATING EPILIMNETIC CHLOROPHYLL IN EUTROPHIC LAKES,
Wisconsin Univ.-Madison. Water Chemistry Lab.
R. E. Stauffer.
Water Resources Research WRERAO, Vol. 24, No. 9, p 1459-1469, September 1988. 3 fig, 11 tab, 13 ref. EPA Research Grants 16010-EHR and R805281010, EPA Training Grant 5P2-WP-184-04, and NSF Grant DEB8012313.

Descriptors: *Limnology, *Eutrophic lakes, *Sampling, *Network design, *Experimental design, *Chlorophyll, *Epilimnion, Estimation, Spatial distribution, Lake Mendota, Biological samples, Error analysis, Lake Delavan, Thermal stratification, Standing crops, Plankton, Cyanophyta, Variation coefficient, Nutrients, Wind.

The spatial distribution of chlorophyll a in Lakes Mendota and Delavan was studied during thermal stratification in 1971 and 1972. Both lakes are calcareous and support large (milligrams/sq m) epilimnetic chlorophyll standing crops (CSC) of planktonic blue-green algae. The root/mean/square (rms) coefficient of variation (CV) between chlorophyll samples 1 m apart in the epilimnetic profile was 23% during sunny, windless interludes following cold fronts. The CV for samples within the profile increased as the two-thirds power of their separation distance. During conditions of elevated wind stress the interstrata CV for chlorophyll converged to the pure analytical error (2-3%). For Mendota, the rms CV (CSC) varied as 7 d sub s or, alternatively, 9.5 d sub s to the 2/3, where d sub s represents the interstation separation distance in kilometers. The rate of increase was greater for Delavan (approximately 13 d sub s), probably because of increased nutrients, hence the increased incidence of large self-shaded and buoyancy-prone chlorophyll standing crops that were readily advected by the wind. Profile sampling near the center of Mendota or Delavan provided an unbiased estimate of pelagic mean CSC with a coefficient of variation of 14%. Lake stations at the margins of the pelagic zone were biased for pelagic mean CSC and also had large temporal CVs. The station biases reflect the prevailing westerly winds; the large CVs reflect the cyclical wind shifts related to cyclonic storms. (Author's abstract)
W89-01242

2I. Water In Plants

LINEAR ROOT WATER UPTAKE MODEL,
Indian Inst. of Science, Bangalore. Dept. of Civil Engineering.
R. Prasad.
Journal of Hydrology JHYDA7, Vol. 99, No. 3/4, p 297-306, May 30, 1988. 5 fig, 1 tab, 7 ref.

Descriptors: *Mathematical models, *Simulation analysis, *Model testing, *Soil-water-plant relationships, *Root zone, Soil water, Roots, Absorption, Errors, Prediction, Comparison studies, Cotton, Safflower, Sorghum, Wheat, Cabbage, Evapotranspiration.

A model of root water extraction is proposed, in which a linear variation of extraction rate with depth is assumed. Five crops (cotton, safflower, grain, sorghum, wheat and early cabbage) were chosen for simulation studies of the model, and soil moisture depletion under optimal conditions from different layers for each crop is calculated. Similar calculations were also made using the constant extraction rate model. Rooting depth is assumed to vary linearly with potential evapotranspiration for each crop during the vegetative phase. The calculated patterns were compared with measured mean depletion patterns for each crop. It is shown that the constant extraction rate model resulted in large errors in the prediction of soil moisture depletion, whereas the proposed linear extraction rate model gave satisfactory results. Hypothetical depletion patterns predicted by the model in combination with a moisture tension-dependent sink term developed elsewhere are indicated. (Author's abstract)
W89-00353

TYPHA PRODUCTIVITY IN A TEXAS POND: IMPLICATIONS FOR ENERGY AND NUTRIENT DYNAMICS IN FRESHWATER WETLANDS,
Texas Univ. at Dallas, Richardson. Graduate Program in Environmental Sciences.
For primary bibliographic entry see Field 2H.
W89-00524

STRUCTURE OF A POPULATION OF LOBELIA DORTMANNA L. ALONG A GRADIENT OF INCREASING DEPTH IN AN OLIGOTROPHIC LAKE,
Gdansk Univ. (Poland). Dept. of Plant Ecology and Nature Protection.
For primary bibliographic entry see Field 2H.
W89-00525

DOES TRANSPIRATION LIMIT THE GROWTH OF VEGETATION OR VICE VERSA,
International Crops Research Inst. for the Semi-Arid Tropics, Patancheru (India).
J. L. Monteith.
Journal of Hydrology JHYDA7, Vol. 100, No. 1/3, p 57-68, July 30, 1988. 2 fig, 19 ref, 1 append.

Descriptors: *Soil-water-plant relationships, *Transpiration, *Vegetation, *Plant growth, Hydrology, Canopy, Photosynthesis, Water use efficiency, Water stress.

For hydrological or agronomic purposes, the potential rate of transpiration from vegetation is often calculated as a function of climatological variables, sometimes with the inclusion of a canopy resistance to water vapor diffusion. If, within leaves, the intercellular concentration of carbon dioxide is conservative, the canopy resistance must depend on the photosynthesis rate, implying that potential transpiration depends on potential growth. The relevant form of the Penman-Monteith equation is developed to link water use efficiency with the conversion coefficient for solar radiation. When water is limiting, the maximum rate at which transpiration can occur depends mainly on the rate of extension of the root system and on the water available per unit soil volume. It follows that both potential and subpotential rates of transpiration are consequences of the assimilation of carbon by vegetation and its subsequent redistribution to form shoots and roots. (Author's abstract)
W89-01013

2J. Erosion and Sedimentation

SUSPENDED MATTER AND BOTTOM DEPOSITS IN THE MAHURY ESTUARINE SYSTEM (FRENCH GUIANA): ENVIRONMENTAL CONSEQUENCES,
Institut de Geologie du Bassin d'Aquitaine, Talence (France).
J. M. Jouanneau, and M. Pujos.
Netherlands Journal of Sea Research NJSRBA, Vol. 21, No. 3, p 191-202, September 1987. 7 fig, 6 tab, 24 ref.

Descriptors: *Sedimentation, *Mahury Estuary, *Estuaries, *French Guiana, *Suspended sediments, *Bottom sediments, Continental shelf, Beaches, Sand, Minerals, Clays, Rivers.

As part of a study carried out on the major rivers in French Guiana to identify and estimate the respective share of local rivers in the sedimentation of estuaries and the inshore continental shelf, results are reported on the Mahury after fieldwork carried out during one dry and one rainy season. The specific characteristics of the whole Mahury fluvio-estuarine system can be summed up as follows: the sands have invariable annual characteristics; they show evidence of a long history, first marine, the continental and finally fluviatile. They play little part in sedimentation on the continental shelf, and what part they do play is limited to the beaches. The fine sediments fall, in terms of their mineralogical and elemental composition, on either side of a limit separating the fluviatile and estuarine zones. Here, the sediment stocks are respectively authigenic and allothogenic, while the clay association and elemental composition in the latter zone are evidence of an Amazonian origin. The contribution of the Mahury (Comte-Orapu) to fine estuarine sedimentation thus appears at present to be a very limited one, whereas the Amazon predomintes over vast coastal areas, including the French Guiana estuaries. (Author's abstract)
W89-00003

NATURAL DEGRADATION ABILITY OF LAKES AND THE ROLE OF DRAINAGE AREA IN THE PROCESS (OCENA NATURALNEJ PODATNOSCI JEZIOR NA DEGRADACJE I ROLA ZLEWNI U TYM PROCESIE),
Warsaw Univ. (Poland). Inst. of Physical Geographic Sciences.
For primary bibliographic entry see Field 2H.
W89-00032

REGULARITIES IN THE FORMATION OF CURVED CHANNELS,
N. R. Grachev, and O. K. Karlykhanov.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 7, p 422-425, January 1988. 3 fig, 10 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 7, p 32-33, July 1987.

Descriptors: *Channel morphology, *Channel flow, *Mathematical equations, *Bank erosion, *Meanders, Prediction, Sinuous flow, Bank protection, Irrigation canals.

The investigation of regularities in the development of planar deformations of river meanders are based on the assumption of a direct relation between planar deformations of the channel and deviation of the center flow line, relative to the axis

of the channel toward the bank being eroded during dominant discharges. Such an investigation develops from an equation for finding the center flow line. It was found that for a planned sinuous channel, it is possible to predict channel deformations with a greater reliability than for a straight channel and to develop bank-protection measures using the method given by Grachev (1984). When designing the route of a sinuous canal with relative radii of curvature of the channel close to 2, or with a variable curvature with average radii of about 3, it is possible to substantially reduce the resistance of the channel, i.e., local energy losses on its bends. In this case, the length, L, of the planned 'meanders' should be close to 5.58, the ratio S/L where S = the length of the channel between points of inflection and L = the length of the meander, should be in the range 1.4 to 1.6, and the angles of turn from 120 to 160 degrees. (Friedmann-PTT)
W89-00041

SOLUTE SOURCES AND TRANSPORT IN AN EPHEMERAL BADLAND CATCHMENT, SOUTHEASTERN ALBERTA, CANADA,
Toronto Univ. (Ontario). Dept. of Geography.
R. A. Sutherland, and R. B. Bryan.
Canadian Journal of Earth Sciences CJESAP, Vol. 25, No. 2, p 167-181, February 1988. 7 fig, 10 tab, 39 ref.

Descriptors: *Sediment load, *Rainfall-runoff relationships, *Solute transport, *Storm runoff, Glacial sediments, Sediment transport, Catchment areas, Silt, Sand, Deposition, Stream sediments, Runoff, Mud, Erosion.

A study was carried out as part of an investigation of water and sediment budgets in an ephemeral catchment in Dinosaur Provincial Park badlands, Alberta. These badlands have developed in Cretaceous mudstones, siltstones, and sandstones, with some glacial and postglacial surficial deposits. Study objectives were (1) to identify major solute sources, (2) to show how these change with storm characteristics, and (3) to assess the proportion of solutes in the total stream budget. Field examination, rainfall-simulation tests, and laboratory experiments showed marked variations in solute production on different lithologic surfaces. This information, when combined with data on threshold precipitation for runoff production from previous experiments, made it clear that solute production in the catchment is significantly influenced by storm characteristics. Observations indicate that in brief, low-intensity storms, runoff occurs only on sandstone, miniature-pediment, and stream channel surfaces. Solute production on these surfaces is limited and is dominated by flushing of salts previously precipitated on the surface. In high-intensity or prolonged storms, runoff also occurs on mudstone surfaces and from subsurface tunnels. In both cases solute production is higher and increases with storm duration because of progressive mudstone dispersion. During the 12 storms monitored, the average stream-solute concentration was 308 mg/L, which is approximately 1.4% of the total stream load. (Author's abstract)
W89-00046

DETERMINATIONS OF SUSPENDED SEDIMENT CONCENTRATIONS FROM MULTIPLE DAY LANDSAT AND AVHRR DATA,
Ohio State Univ., Columbus. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7B.
W89-00064

LANDSAT-MSS RADIANCE AS A MEASURE OF SUSPENDED SEDIMENT IN THE LOWER YELLOW RIVER (HWANG HO),
Exeter Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 7B.
W89-00065

PARTICULATE CONCENTRATIONS IN LAKE ST. CLAIR AS RECORDED BY A SHIPBORNE MULTISPECTRAL OPTICAL MONITORING SYSTEM,
National Water Research Inst., Burlington (Ontario). Rivers Research Branch.
For primary bibliographic entry see Field 7B.
W89-00066

EFFECT OF RUNOFF VARIABILITY ON DEFORMATION OF ERODIBLE CHANNELS NEAR STRUCTURES,
G. V. Zheleznyakov, and Y. V. Pisarev.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 4, p 220-224, October 1987. 4 fig, 1 tab, 4 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 4, p 37-40, April 1987.

Descriptors: *Runoff, *Deformation, *Channel erosion, *Erosion, Rheology, Channels, Variability, Hydrology, Stochastic hydrology, Stochastic process, Design criteria.

A stochastic study of processes of channel deformation was conducted and compared with data from on-site observations. A bridge across a large river with a readily mobile channel (channel braiding) was selected as the object of study. The morphological series are characterized by loss of correlation with the time- and space-corresponding initial hydrological series with respect to the probability of the parameters entering into these series. This property is displayed in complex cases of the fluvial process and can be explained by the increasing asynchronism under such conditions between the morphological process and the process of variation of the discharge. It is concluded that it is necessary to develop the theoretical basis and methods of calculating erosive activity with consideration of the stochastic component of the fluvial process, since water discharges and hydrological-morphological characteristics in the general case have different probabilities. (Doria-PTT)
W89-00072

EFFECT OF SEDIMENT DEPTH AND SEDIMENT TYPE ON THE SURVIVAL OF VALLISNERIA AMERICANA MICHX GROWN FROM TUBERS,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2H.
W89-00114

EFFECTS OF SEDIMENT PROPERTIES ON BENTHIC PRIMARY PRODUCTION IN THE COLUMBIA RIVER ESTUARY,
Oregon State Univ., Corvallis. Dept. of Botany and Plant Pathology.
For primary bibliographic entry see Field 2L.
W89-00115

GREAT LAKES SHORE EROSION,
Citadel, Charleston, SC.
For primary bibliographic entry see Field 4D.
W89-00133

OUTWELLING FROM TROPICAL TIDAL SALT FLATS,
Australian Inst. of Marine Sciences, Townsville.
For primary bibliographic entry see Field 2L.
W89-00140

CHEMICAL CHARACTERISTICS OF BOTTOM SEDIMENT TOP LAYER IN SZCZYTNO MALE LAKE,
Wyzsza Szkola Nauczycielska w Slupsku (Poland). Dept. of Chemistry.
For primary bibliographic entry see Field 2H.
W89-00237

SORPTION OF CATIONS BY BOTTOM SEDIMENTS OF SZCZYTNO MALE AND LETOWO LAKES, WITH CAGE TROUT CULTURE,
Wyzsza Szkola Nauczycielska w Slupsku (Poland). Dept. of Chemistry.
For primary bibliographic entry see Field 2H.
W89-00239

SORPTION PROPERTIES OF BOTTOM SEDIMENTS OF SZCZYTNO MALE AND LETOWO LAKES,
Wyzsza Szkola Nauczycielska w Slupsku (Poland). Dept. of Chemistry.
For primary bibliographic entry see Field 2H.
W89-00256

DEMPSTER'S RULE OF COMBINATION IN SOIL-LOSS PREDICTION,
S. Toussi, and R. M. Khanbilvardi.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 114, No. 4, p 432-445, July 1988. 4 fig, 6 tab, 11 ref, 2 append.

Descriptors: *Dempster's Rule, *Soil erosion, *Mathematical studies, Erosion, Soil conservation, Evaluation, Case studies, Nebraska, Runoff, Mathematical equations.

Soil erosion has long been a major problem and continues to threaten soil conservation worldwide. To deal effectively with this problem, the first step is to obtain a reasonably accurate prediction of the soil loss. An inference procedure to combine soil loss predictions obtained from different methods is used, with the objective being to minimize the uncertainty associated with the applied techniques. The procedure is performed satisfactorily in test routings on two Nebraska watersheds. A similar procedure will be used in erosion and runoff control evaluations. (Author's abstract)
W89-00303

SEDIMENT DELIVERY IN A SEMI-ARID COASTAL STREAM,
San Diego State Univ., CA.
H. H. Chang, and D. A. Stow.
Journal of Hydrology JHYDA7, Vol. 99, No. 3/4, p 201-214, May 30, 1988. 12 fig, 1 tab, 15 ref. NOAA, National Sea Grant College Program, Grant NA85AA-D-SG140, Project R/CZ-79.

Descriptors: *Sediment transport, *Sediment yield, *Bed-load discharge, *Semiarid lands, Coastal streams, Mathematical models, Channel storage, Boundary conditions, Hydraulic geometry, Buena Vista Creek, California, Suburban areas.

The transport and yield of bed sediment in a small coastal stream flowing primarily through suburban areas. Spatial and temporal variations of sediment characteristics were simulated using a calibrated mathematical model for time-dependent fluvial process-response. The study illustrates how channel storage, a major factor affecting sediment yield, can be quantified by an erodible-boundary model. The mathematical model also accounts for the storage effects caused by the works of man, a task that cannot be easily accomplished by other methods. The model simulates the interrelated changes in channel-bed profile and channel width based upon the stream's tendency to seek uniformities in sediment discharge and power expenditure. Scour and fill of the channel bed are accompanied by significant changes in channel width, which may contribute more to sediment storage. Thus, sediment routing must be based upon an erodible-boundary model rather than an erodible-bed model. This study confirms field evidence of the significant variation in sediment yield that occurs along the stream reach. (Author's abstract)
W89-00346

PHYSICOCHEMICAL AND GEOTECHNICAL CHARACTERISTICS OF RECENT SAGUENAY FJORD SEDIMENTS,
Laval Univ., Quebec. Dept. de Geologie.
J. Locat, and S. Leroueil.
Canadian Geotechnical Journal CGJOAH, Vol. 25, No. 2, p 382-388, May 1988. 6 fig, 2 tab, 21 ref.

Descriptors: *Fjords, *Saguenay Fjord, *Geochemistry, *Physicochemical properties, *Marine sediments, Soil chemistry, Geophysics, Mineralogy, Sediments, Quebec, Diagnosis, Soil mechanics.

In the spring of 1985 the first geotechnical reconnaissance of recent Saguenay Fjord sediments took place, in which were recorded the two Saint-Jean-Vianney slides of 1663 and 1971. Cores from the upper part of the fjord were tested onboard the

ship and in the laboratory. The mineralogy of the recent sediments is like that of the raised marine deposits of the area, except for the organic content, which is higher. The microstructure of the sediment is quite typical of flocculated marine soils. The freshly sedimented soil, in its sedimentary environment, has gained strength and sensitivity (up to 12) in excess of what is usually expected for such material. It concluded that the physicochemical characteristics of the sediment, such as depicted by its initial plasticity (before leaching), are first-order parameters in the source of apparent overconsolidation and structuration. (Author's abstract)
W89-00390

EFFECT OF SODIUM NITRATE AND GYPSUM ON INFILTRATION AND EROSION OF A HIGHLY WEATHERED SOIL,
Georgia Univ., Athens. Dept. of Agronomy.
For primary bibliographic entry see Field 2G.
W89-00409

STOKES SURFACES AND THE EFFECTS OF NEAR-SURFACE GROUNDWATER-TABLE ON AEOLIAN DEPOSITION,
McAdams, Roux and Associates, Denver, CO.
S. G. Fryberger, C. J. Schenk, and L. F. Krystinik.
Sedimentology SEDIAT, Vol. 35, No. 1, p 21-41, February 1988. 20 fig, 1 tab, 32 ref.

Descriptors: *Wind erosion, *Deposition, *Beaches, *Sand seas, *Stokes surfaces, *Aeolian deposits, *Groundwater table, Water table, Erosion, Chemical precipitation, Soil properties, Deposition, Soil water.

Stokes surfaces in aeolian deposits are caused by wind scour of unconsolidated material to a roughly planar horizon controlled by near-surface watertables. A water table forms a downward limit of scour through the cohesion of damp or wet sand near water table, and through early cementation by evaporites precipitated in the sediments as water evaporates near the sand-air interface. Study of modern analogues reveals that Stokes surfaces exist in a variety of depositional settings, including a coastal offshore prograding sand sea (Jafurah, Saudi Arabia); a coastal onshore prograding sand sea (Guerrero Negro, Mexico) and a continental sand sea (White Sands, New Mexico). These modern analogues indicate that the concept of Stokes surfaces must be broadened to include the following: (1) modern analogues for Stokes surfaces in ancient rocks as hypothesized plains of deflation requiring removal of entire sand seas; (2) Stokes surfaces occupy a continuum in scale from local to extensive, and erosional surfaces of different magnitude may be stacked closely in the sediments; (3) Stokes surfaces, although erosional in nature, are commonly associated with deposits both above and below the Stokes bounding surface which plainly reveal the influence of a near-surface groundwater control on wind sedimentation. Moreover, the erosional relief of the bounding surface itself (as well as other features) reveals the influence of a groundwater table; (4) Stokes surfaces may be diachronous, representing the lateral shift of a zone of scour within a sand sea rather than simultaneous removal of all dunes from the area encompassed by the erosional surface; (5) Stokes surfaces and associated deposits are often laterally transitional to surfaces and deposits of adjacent depositional environments, including interdunes, tidal flats, lagoons, beaches, lakes and non-aeolian sabkhas. Finally, modern examples from different depositional settings suggest that while most Stokes surfaces have many features in common (such as erosional ridges due to early cementation), there are some features which may, with further study, be revealed to be distinctive of an individual depositional setting. (Author's abstract)
W89-00410

SEDIMENT TRANSPORT AND BED MORPHOLOGY AT RIVER CHANNEL CONFLUENCES,
Hull Univ. (England). Dept. of Geology.
J. L. Best.
Sedimentology SEDIAT, Vol. 35, No. 1, p 481-498, February 1988. 16 fig, 2 tab, 48 ref.

Descriptors: *Channel morphology, *Confluent streams, *Channel confluences, *Sediment transport, River beds, Channels, Morphology, Scour, Avalanches, Sediment load, Model studies, Flumes, Artificial watercourses, Rivers.

River channel confluences form important morphological elements of every river system, being points at which rapid changes in flow, sediment discharge and hydraulic geometry must be accomodated. This article presents results of a quantitative investigation of sediment transport at channel confluences accomplished through both scaled laboratory flume simulation and complementary monitoring of a natural channel confluence. Bed morphology at channel confluences is characterized by three distinct elements: avalanche faces at the mouth of each confluent channel, a deep central scour and a bar within the separation zone formed at the downstream junction corner. These elements are controlled predominantly by the confluence angle and the ratio of discharges between the tributary and mainstream channels. As confluence angle and discharge ratio increase, the sediment contributions from the confluent channels are progressively segregated in their paths through the junction, with sediment being transported around rather than through the center of the confluence. This segregation of sediment loads is accompanied by the retreat of the main channel avalanche face from the confluence, an increase in the scour depth, a change in the orientation of the scour and an increase in the size of separation zone bar. Field measurements closely replicate the flume simulation. A model of sediment transport and bed morphology links these features to the fluid dynamics of these sites. An understanding of confluence dynamics is important not only in consideration of channel morphology and design criteria, but must form the basis for the interpretation of confluence sediments in the ancient record. (Author's abstract)
W89-00411

FLOW REGIMES AND DYNAMIC EQUILIBRIUM OF MORPHOLOGICAL CHANGES AT KOYCEGIZ LAKE INLET, TURKEY,
Middle East Technical Univ., Ankara (Turkey). Coastal and Harbor Engineering Center.
For primary bibliographic entry see Field 8B.
W89-00449

FLUVIAL SEDIMENTATION IN THE EBB-DOMINATED ORANGE ESTUARY,
National Research Inst. for Oceanology, Stellenbosch (South Africa). Marine Geoscience Div.
I. L. Van Heerden.
South African Journal of Science SAJSAR, Vol. 82, No. 3, p 141-147, March 1986. 9 fig, 1 tab, 27 ref.

Descriptors: *South Africa, *Orange Estuary, *Ebb tide, *Sedimentation, Estuaries, Fluvial sediments, Tides, Deltas.

Aerial photography, since 1938, reveals that there has been marked sedimentation in the Orange Estuary. In addition, the estuary mouth is continuously migrating across a beach barrier. A study of these processes was initiated in 1983 and an assessment made as to the relative roles of fluvial and marine processes. Sedimentation in the estuary is fluvially dominated and distributary channel extension and bifurcation is the primary mechanism of subaerial delta lobe growth. Estuary mouth migration is controlled by major flood-induced shifts of the river, wave refraction, and cross-sectional asymmetry in outflow inertia. From a management viewpoint: although the estuary has attained a sediment-filled state, increase in the dimensions of the tidal basin as a result of subsidence due to dewatering of the fine-grained estuarine sediments, as well as reduced river discharge, may mean that tidal processes will become more important. Salt water may penetrate farther up the estuary than in the immediate past, resulting in some biological changes. In addition, closure of the mouth may become more common, producing associated biological responses. (Lantz-PTT)
W89-00456

ROLES OF SEDIMENTATION AND PLANT GROWTH IN CHANGING FLOW PATTERNS IN THE OKAVANGO DELTA, BOTSWANA,
University of the Witwatersrand, Johannesburg (South Africa). Dept. of Geology and Botany.
T. S. McCarthy, W. N. Ellery, K. H. Rogers, B. Cairncross, and K. Ellery.
South African Journal of Science SAJSAR, Vol. 82, No. 10, p 579-584, October 1986. 10 fig, 19 ref.

Descriptors: *South Africa, *Sedimentation, *Plant growth, *Okavango River, *Deltas, *Channel flow, Botswana, Aggradation, Channeling, Aquatic vegetation.

Individual distributaries of the Okavango Delta are subject to progressive blockage and ultimately are abandoned, on a time scale of 50 to 100 years, and new channel systems form in consequence. This constant migration of channels is apparently the result of sediment accumulation in channels, which causes aggradation of channel beds, accompanied by vertical aggradation of the flanking vegetation. The rate of aggradation may exceed 5 cm/yr. This aggradation ultimately reduces hydraulic gradients down the channels, resulting in a decline in flow velocity and hence progressive vegetation blockage. Water is redirected as a result, and new channel systems are created. (Author's abstract)
W89-00457

DYNAMIC CHANGES AND PROCESSES IN THE MISSISSIPPI RIVER DELTA,
Louisiana State Univ., Baton Rouge. Coastal Studies Inst.
J. M. Coleman.
Geological Society of America Bulletin BUGMA, Vol. 100, No. 7, p 999-1015, July 1988. 24 fig, 50 ref.

Descriptors: *Sedimentation, *Erosion, *Rivers, *Deltas, *Mississippi River, *Geomorphology, River mouth, Deltaic lobes, Geologic history, Deposition, Bay fills, Overbank splays, Floods, Distributaries, Diapirs, Mudflows.

Research in the modern delta of the Mississippi River has revealed short-term changes and processes that are of significant magnitude. Deltaic lobes, each lobe covering an area of 30,000 sq km and having an average thickness of 35 km, switch sites of deposition on an average of every 1500 yr. Through short periods of geologic time, this process results in a relatively thick accumulation of stacked deltaic cycles covering extremely large areas. Within a single delta lobe, and operating on an even higher frequency, are bay fills and overbank splays. Bay fills, having areas of 250 sq km and thickness of 15 m, require only 150 yr to accumulate. Four major events have taken place in the modern Balize delta since 1838. Overbank splays are much smaller, covering areas of less than 2 sq km and having thickness of 3 m, but are associated with high floods on the river. At the river mouth, continued progradation of the distributary channel can form distributary mouth sand bodies that have dimensions of 17 km long, 8 km wide, and a thickness of 80 m in a period of only 200 yr. Differential sedimentary loading at the river mouth results in formation of diapirs that display vertical movements in excess of 100 m in period of 20 yr. On the subaqueous delta platform, sediment instabilities operate nearly continuously, mass-moving large quantities of shallow-water deposits to deeper-water environments via arcuate rotational slides and mudflow gullies and depositional lobes. All of these changes and processes operate at differing spatial and temporal scales, but all result in deposition of large volumes of sediment over extremely short periods of time. (Author's abstract)
W89-00469

FORMATION AND FAILURE OF NATURAL DAMS,
Cascades Volcano Observatory, Vancouver, WA.
J. E. Costa, and R. L. Schuster.

Geological Society of America Bulletin BUGMA, Vol. 100, No. 7, p 1054-1068, July 1988. 13 fig, 7 tab, 122 ref.

Descriptors: *Dams, *Landslides, *Dam failure, *Natural dams, *Literature review, Geologic formations, Glaciers, Moraines, Avalanches, Rockslides, Mudflows, Glacial lakes, Wave action, Flooding, Flood peak.

Of the numerous kinds of dams that form by natural processes, dams formed from landslides, glacial ice, and late-neoglacial moraines present the greatest threat to people and property. The most common types of mass movements that form landslide dams are rock and debris avalanches; rock and soil slumps and slides; and mud, debris, and earth flows. In a sample of 72 documented landslide-dam failures, 27% of the dams failed less than one day after formation, and about 50% failed within 10 days; overtopping was by far the most common cause of failure. Glacial-ice dams can produce at least nine kinds of ice-dammed lakes. Failure can occur by erosion of a drainage tunnel under or through the ice dam or by a channel over the dam. Late-neoglacial moraine-dammed lakes are located in steep mountain areas affected by the advances and retreats of valley glaciers in the last several centuries. The most common reported failure mechanism is overtopping and breaching by a wave or series of waves in the lake generated by icefalls, rockfalls, or snow or rock avalanches. Natural dams may cause upstream flooding as the lake rises and downstream flooding as a result of failure of the dam. Although data are few, for the same potential energy at the dam site, downstream flood peaks from the failure of glacier-ice dams are smaller than those from landslide, moraine, and constructed earth-fill and rock-fill dam failures; moraine-dam failures appear to produce some of the largest downstream flood peaks. Differences in flood peaks of natural-dam failures appear to be controlled by dam characteristics and failure mechanisms. (Author's abstract)
W89-00470

ANALYSIS OF THE EFFECTS OF SUSPENDED SEDIMENT OF HUANGHE RIVER ON HARBOR CONSTRUCTION BY USING NOAA IMAGES, (IN CHINESE),
Tianjin Inst. of Water Transport Engineering (China).
J. Zhongxi, and W. Lingping.
Oceanologia et Limnologia Sinica OECOBX, Vol. 18, No. 3, p 244-248, May 1987. 1 fig, 1 tab, 1 ref. English summary.

Descriptors: *Estuaries, *Harbors, *Construction, *Sedimentation, Diffusivity hydraulics, Huanghe River, China.

The diffusion forms are quite different in different sections of the Huanghe River estuary. Since the Huanghe River emptied into the sea through the Qingshui Gullet in 1976, a clear diffusion boundary appeared, most of the sediments are settled down within the boundary. There is no intense drift along the coast on both sides of the Huanghe River estuary. Therefore, there is no direct effect upon the harbor construction along the coasts of Hebei and Shandong provinces. (Author's abstract)
W89-00536

PROBING INTO THE COMPUTATION METHOD ON SEDIMENTARY AMOUNT OF POYANG LAKE, (IN CHINESE),
Jiangxi Traffic Inst., Nanchang (China).
For primary bibliographic entry see Field 2H.
W89-00540

STUDIES ON MARINE HUMIC SUBSTANCES: III. THE DISTRIBUTION OF HUMIC SUBSTANCES IN SEAWATER AND SEDIMENTS IN THE ESTUARY OF CHANGJIANG RIVER AND EAST CHINA SEA, (IN CHINESE),
Academia Sinica, Qingdao (China). Inst. of Oceanology.
For primary bibliographic entry see Field 2L.
W89-00541

CALCULATION OF THE SUSPENDED LOAD IN RIVERS AND CANALS,
For primary bibliographic entry see Field 7B.
W89-00552

CALCULATION OF CHANNEL DEFORMATIONS OF LARGE EARTH CANALS WITH DAMLESS WATER INTAKE FROM RESERVOIRS,
For primary bibliographic entry see Field 8A.
W89-00553

GEOMORPHOLOGY, OFFSHORE BATHYMETRY AND QUATERNARY LITHOSTRATIGRAPHY AROUND THE BOT RIVER ESTUARY,
Geological Survey of South Africa, Bellville.
For primary bibliographic entry see Field 2L.
W89-00649

BARRIER/ESTUARINE PROCESSES. BOT RIVER ESTUARY: AN INTERPRETATION OF AERIAL PHOTOGRAPHS,
Specialist Offshore Surveys Pty Ltd., Newlands (South Africa).
For primary bibliographic entry see Field 2L.
W89-00650

BATHYMETRY, ENVIRONMENTAL PARAMETERS AND SEDIMENTS OF THE BOT RIVER ESTUARY, S.W. CAPE PROVINCE.
Cape Town Univ. (South Africa). Dept. of Geochemistry.
For primary bibliographic entry see Field 2L.
W89-00651

NUMERICAL MODEL FOR THE WIND-DRIVEN CIRCULATION IN THE BOT RIVER ESTUARY,
Cape Town Univ. (South Africa). Dept. of Oceanography.
For primary bibliographic entry see Field 2L.
W89-00652

SYNOPSIS OF THE IMPACT OF ARTIFICIALLY OPENING THE MOUTH OF THE BOT RIVER ESTUARY: IMPLICATIONS FOR MANAGEMENT,
Cape Town Univ. (South Africa). Dept. of Zoology.
For primary bibliographic entry see Field 2L.
W89-00666

METHODS FOR ESTIMATING THE CRITICAL SHEAR STRESS OF INDIVIDUAL FRACTIONS IN MIXED-SIZE SEDIMENT,
Massachusetts Inst. of Tech., Cambridge. Dept. of Earth, Atmospheric and Planetary Sciences.
P. R. Wilcock.
Water Resources Research WRERAO, Vol. 24, No. 7, p 1127-1135, July 1988. 4 fig, 18 ref. Office of Naval Research Contracts N00014-80-C-0273 and N00014-86-K-0325.

Descriptors: *Sediment transport, *Mathematical analysis, *Shear stress, Mixed-sized sediment, Critical shear stress, Sediments, Particle size, Initial motion.

Two methods are commonly used to estimate the critical shear stress of individual fractions in mixed-size sediment, one using the largest grain displaced, the other using the shear stress that produces a small value of transport rate for each fraction. The initial-motion results produced by the two methods are typically different: largest-grain critical shear stresses vary with roughly the square root of grain size, and reference transport critical shear stresses show little variation with grain size. Comparison of the two methods is seldom possible because both methods can rarely be applied to the same data. The one case known for which both methods can be used suggests that the typical differences in initial-motion results reflect more methodological influence than real differences in the initial motion of different sediments. Although the two classes of methods may not be directly compared, a general definition of initial-motion in mixed-size sediment is presented that allows the characteristic differences between the results to be explained in terms of sampling and scaling considerations inherent in the mixed-size initial-motion problem. The initial-motion criterion defined also provides a rational basis for collecting comparable and reproducible data using the two classes of methods. (See also W89-00721) (Author's abstract)
W89-00720

EXPERIMENTAL STUDY OF INCIPIENT MOTION IN MIXED-SIZED SEDIMENT,
Massachusetts Inst. of Tech., Cambridge. Dept. of Earth, Atmospheric and Planetary Sciences.
P. R. Wilcock, and J. B. Southard.
Water Resources Research WRERAO, Vol. 24, No. 7, p 1137-1151, July 1988. 11 fig, 6 tab, 26 ref. Office of Naval Research Contracts N00014-80-C-0273 and N00014-86-K-0325.

Descriptors: *Sediment transport, *Shear stress, Mixed-sized sediment, Incipient motion, Particle size, Initial motion, Sediment sorting.

Transport rates of five sediments were measured in a laboratory flume. Three of these sediments had the same mean size, the same size distribution shape, and different values of grain size distribution standard deviation. The critical shear stress for incipient motion of the individual size fractions within these sediments was estimated as that shear stress that produced a small dimensionless transport rate. The sorting of the sediment mixture had little effect on the critical shear stress of individual fractions, once the median size (D50) of the mixture and a fraction's relative size (Di/D50) are accounted for. The data combined with previously published data, show a remarkably consistent relation between the critical shear stress of individual fractions and the fraction's relative grain size, despite a broad variation in the available data of mixture sorting, grain size distribution shape, mean grain size, and grain shape. All fractions in a size mixture begin moving at close to the same value of bed shear stress during steady state transport conditions. This result is apparently true for transport systems where the transport rates of individual fractions are determined solely by the flow and bed sediment (recirculating systems), as well as for systems where the fractional transport rates are imposed on the system (feed systems). This equivalence in initial-motion results is important because natural transporting systems often show attributes of both types of behavior in an unknown combination. (See also W89-00720) (Author's abstract)
W89-00721

SEDIMENT ANALYSIS: LABILITY OF SELECTIVELY EXTRACTED FRACTIONS,
Newcastle Univ. (Australia). Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W89-00744

MICROBIAL-MEIOFAUNAL INTERRELATIONSHIPS IN SOME TROPICAL INTERTIDAL SEDIMENTS,
Australian Inst. of Marine Sciences, Townsville.
For primary bibliographic entry see Field 2L.
W89-00766

PROVISIONAL DIAGENETIC MODEL FOR PH IN ANOXIC POREWATERS: APPLICATION TO THE FOAM SITE,
British Columbia Univ., Vancouver. Dept. of Oceanography.
B. P. Boudreau, and D. W. Canfield.
Journal of Marine Research JMMRAO, Vol. 46, No. 2, p 429-455, May 1988. 7 fig, 4 tab, 84 ref, append. NSERC Grant U0506 and NSF Grants OCE 8219580 and 8508472.

Descriptors: *Marine sediments, *Anaerobic conditions, *Foam site, *Hydrogen ion concentration, *Pore water, *Infiltration, *Model studies, Sediments, Chemical reactions, Capillary water, Chemical properties, Long Island Sound, Advection,

Equilibrium, Decomposing organic matter, Soil chemistry.

This paper presents a diffusion-advection-reaction model for the pH of anoxic porewaters in nonirrigated sediments. Because of the couplings demanded by the organic-matter decay reaction, various acid-base interconversions, dissolved-iron generation, and CaCO3 and FeS precipitation, the model does not consider H+ alone, but deals simultaneously with 17 dissolved species. The complex and largely unknown kinetics of some of the processes affecting these species have been approximated by simple ad hoc formulations. For this reason, the model must be considered provisional. The authors have also made extensive use of the local (partial) equilibrium assumption to circumvent the computational problems generated by rapid association/dissociation reactions. The FOAM Site data are used as a vehicle to display the capabilities of this model. Assuming local equilibrium with FeS, the predicted pH profile is most sensitive to the reaction that liberates iron from the solid phase. The FOAM pH does not conform to a profile expected for any one iron-source mineral, but appears to reflect a composite source. Based on currently available data, this source might include magnetite and silicate minerals, but is unlikely to involve ferric oxides and hydroxides. The pH of FOAM porewaters is much less sensitive to the precipitation of FeS and CaCO3 than would be suggested by past closed-system models. The overall pH stability of anoxic porewaters is attributable to the fact that the dissolved products of organic-matter decomposition are added in such a way as to form a self-buffering mixture. (Author's abstract)
W89-00767

COASTAL TOPOGRAPHY OF THE MORAY FIRTH,
Aberdeen Univ. (Scotland). Dept. of Geography.
For primary bibliographic entry see Field 2L.
W89-00775

BIOTURBATION, MICROBIAL ACTIVITY AND SEDIMENT PROPERTIES IN AN ESTUARINE ECOSYSTEM,
Glasgow Univ. (Scotland). Dept. of Zoology.
For primary bibliographic entry see Field 2L.
W89-00806

BASIN SEDIMENTATION AND THE GROWTH OF PROGRADING DELTAS,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia).
J. P. Syvitski, J. N. Smith, E. A. Calabrese, and B. P. Boudreau.
Journal of Geophysical Research (C) JGRCEY, Vol. 93, No. 6, p 6895-6908, June 15, 1988. 15 fig, 2 tab, 43 ref.

Descriptors: *Turbidity currents, *Sedimentation, *Deposition, *Model studies, *Deltas, Plumes, Rivers, Velocity distribution, Numerical analysis, Channels, Benthic environment, Accumulation, Mass transfer, Basins.

A theoretical model is developed for the infilling of a basin by the progradation of a delta. The model simulates four mechanisms for the transfer of sediment from the land to the sea: 1. bed load dumping along the delta front, 2. hemipelagic sedimentation under the seaward flowing river plume, 3. proximal slope bypassing by turbidity currents, and 4. the combined effects of both short-term, wave and tidal action, and long-term, creep and small slides, downslope diffusion of the accreting sediment mass. The general model is of relatively low precision, useful for predicting basin infilling on time scales greater than a few hundred years. The river plume portion of the model can predict sedimentation on time scales of less than a year and is designed to reflect the dynamics of a free, two-dimensional, buoyant jet that transports a composite size population of suspended particles. The general model allows the prediction of lithologies changing with time and space. The model has been used to simulate infilling processes for Knight and Bute inlets, two grabenlike basins along the coast of British Columbia. Model simulations of delta progradation over the last 10,000 years favorably predicted the modern seafloor bathymetry and sediment accumulation rates to within a factor of 2 of measured Pb, Cs, and sediment trap rates. (Author's abstract)
W89-00832

RECENT TRANSPORT OF METALS IN THE RIVER SEVERN AS RECORDED BY THE SEDIMENTS OF CHELMARSH RESERVOIR, SHROPSHIRE, U.K.,
Exeter Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 5B.
W89-00885

SCOUR CHANNEL DEVELOPMENT AFTER SPILLWAY FAILURE,
Illinois State Water Survey Div., Champaign.
M. Demissie, V. A. Tsihrintzis, W. C. Bogner, and N. G. Bhowmik.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 114, No. 8, p 844-860, August 1988. 13 fig, 1 tab, 17 ref, append.

Descriptors: *Spillway failure, *Channel scour, *Channel morphology, *Lake Charleston, *Dam failure, Simulation analysis, Hydraulic structures, Illinois, Spillways.

Hydraulic structure failure such as the failure of the spillway of a dam may afford the opportunity to evaluate the impacts of this type of event on the formation and migration of a scour channel upstream of the spillway. Such an event occurred in November 1985 at the Lake Charleston dam in Illinois. A portion of the spillway failed during a moderate flood event, and the resulting concentrated flow developed a scour hole ('sinkhole') which migrated upstream until its movement was halted by a rock ledge. The bed elevation of this scour channel was much lower than the original lake bed. Field data on velocity distribution, bed material characteristics, stream gradient, and stream cross sections were collected to evaluate this hydraulic phenomenon. These data and existing streamflow and sediment rating information were used to simulate this event quite satisfactorily. Analysis such as this can be a valuable tool in evaluating natural disasters such as the sudden failure of overflow structures along a waterway. (Author's abstract)
W89-00897

LABORATORY ANALYSIS OF MUDFLOW PROPERTIES,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
J. S. O'Brien, and P. Y. Julien.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 114, No. 8, p 877-887, August 1988. 5 fig, 2 tab, 30 ref, append.

Descriptors: *Mudflows, *Viscometers, *Rheology, *Shear tests, *Viscosity, Laboratory equipment, Rheology, Clays, Silt, Landslides.

A rotational viscometer was designed for laboratory measurements of the rheological properties of natural mudflow deposits in Colorado. The mudflow matrices comprised of silt and clay particles are sheared under temperature-controlled conditions at volumetric sediment concentrations ranging from 0.10-0.45. The importance of conducting rheological measurements at low rates of shear is stressed because: 1) Those are the conditions found in natural channels; and 2) they avoid the slippage problems observed at large sediment concentrations. At low rates of shear, the Bingham model is fitted to the measured rheograms, and both the viscosity and yield stress increase exponentially with the sediment concentration of the fluid matrix. Both the yield stress and the viscosity increase by three orders of magnitude as the volumetric concentration of sediments in the fluid matrix changes from 0.10 to 0.40. The addition of sand particles does not significantly alter the rheological properties of the matrix unless the volumetric concentration of sands exceeds 0.20. (Author's abstract)
W89-00899

SUSPENSION OF LARGE CONCENTRATIONS OF SANDS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
H. S. Woo, P. Y. Julien, and E. V. Richardson.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 114, No. 8, p 888-898, August 1988. 4 fig, 1 tab, 16 ref, append.

Descriptors: *Suspension, *Suspended sediments, *Sand, *Sediment carrying capacity, *Sediment transport, Vertical distribution, Mathematical models, Viscosity, Fall velocity, Turbulent flow.

Existing methods based on the diffusion theory have been extended to determine the sediment concentration distribution for large concentrations of sand. The modifications for volumetric concentrations ranging from 4 to 20% include decreased fall velocity, and increased viscosity and specific weight of the suspension. The sediment concentration profiles are sensitive to the velocity profiles and the fall velocity of sediment particles. In turbulent flows, either a power law or a two-layer logarithmic law can be used to describe the velocity profiles and the sediment diffusivity. The proposed method accurately depicts the deviation from the Rouse equation at large concentrations of sands, and the agreement with sediment concentration profiles measured by Einstein and Chien is excellent. The proposed numerical solution gradually reduces to the relationships of Karim and Kennedy, and Rouse as the volumetric concentration decreases below 4%. (Author's abstract)
W89-00900

CHANNEL CHANGE AND SEDIMENT TRANSPORT IN REGULATED U.K. RIVERS,
Freshwater Biological Association, Ambleside (England).
P. A. Carling.
Regulated Rivers Research and Management RRRMEP, Vol. 2, No. 3, p 369-387, July-August 1988. 10 fig, 2 tab, 76 ref.

Descriptors: *Regulated rivers, *Regulated flow, *Channel morphology, *Sediment transport, *Hydraulic geometry, Deposition, Reservoir effects, Model studies, Dam effects.

The history of investigations of channel change consequent upon river regulation is traced from the late 1960s until the present. The associated sediment transport and depositional processes are also reviewed. The approaches adopted historically have fallen into three basic categories: (1) analyses of the changes in channel networks as evident in adjustments to hydraulic geometry related to catchment area, (2) analyses concerned with sediment transport processes and channel adjustments at the reach scale, and (3) an integrated approach using holistic concepts of channel change over extended time periods. A major conclusion is that each reservoir-catchment system is unique, producing singular responses that cannot easily be integrated into a basic general model except at a facile level. The continuing lack of complete theoretical models of channel adjustment is a hinderance in predicting regulation effects and may be related to limited understanding of such factors as sediment supply dynamics and bank collapse mechanisms. Emphasis is placed on: (1) the importance of the aggregational as well as the well-known degradational response of channels below dams, (2) the recognition of suitable temporal frameworks, (3) the potentially destabilizing effect of rare large floods, and (4) the local effects of unregulated tributary inflows. (Author's abstract)
W89-00958

SORPTION AND DESORPTION DYNAMICS OF AROCLOR 1242 TO NATURAL SEDIMENT,
Princeton Univ., NJ. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-00991

SEDIMENTATION OF PARTICULATE MATERIAL IN TWO SHALLOW, LAND-LOCKED FJORDS IN WESTERN NORWAY,
Bergen Univ. (Norway). Inst. of Marine Biology.
P. Wassmann.
Sarsia, Vol. 70, No. 4, p 317-331, 1985. 8 fig, 6 tab, 54 ref.

Descriptors: *Sedimentation, *Lakes, *Fjords, *Norway, *Particulate matter, Suspended solids, Vagsbopollen, Kviturdvikpollen, Water circulation, Mineralization, Organic carbon, Phytoplankton, Algae, Shallow lakes, Seasonal variation, Primary productivity, Productivity.

Measurements of particulate matter were made in the highly stratified Vagsbopollen (10 m depth) and the less stratified Kviturdvikpollen (15 m depth), two small fjords (polls), receiving fresh water from a small, glacier-free watershed. Cylindrical traps positioned at 5 and 8 m in Vagsbopollen and 10 and 13 m in Kviturdvikpollen were used from March to August and February to September 1982, respectively. Gross sedimentation of total particulate material generally decreased with increasing depth in the two polls during sampling intervals with stagnant bottom water. Total particulate matter sedimentation increased with increasing depth in Kviturdvikpollen during periods of bottom-water exchange. The depth-related decrease or increase of gross sedimentation is explained by the combined effect of secondary sedimentation and planktonic mineralization. Low-turbulent water movement decreases the impact of resuspension with increasing water depth, and the planktonic mineralization in the stabilized water column is supposed to increase. High-turbulent water movement increases resuspension with increasing water depth and probably decreases planktonic mineralization. The average daily loss rates of suspended organic carbon were higher in Kviturdvikpollen (8%) compared to Vagsbopollen (5%) with maxima at the end of the phytoplankton spring bloom. The daily loss rates were, however, lowest during summer with maximum water-column stability and suspended biomass. Calculations on the seasonal supply and loss of particulate organic matter revealed that more than 35 and 44% of the total supply were sedimented in Vagsbopollen and Kviturdvikpollen, respectively. It is proposed that increasing stratification and stagnation of the bottom water result in increasing plankton consumption and decreasing sedimentation. (See also W85-05713) (Author's abstract)
W89-01008

EROSION AND SEDIMENT YIELD RESEARCH: SOME RECENT PERSPECTIVES,
Exeter Univ. (England). Dept. of Geography.
D. E. Walling.
Journal of Hydrology JHYDA7, Vol. 100, No. 1/3, p 113-141, July 30, 1988. 9 fig, 5 tab, 70 ref.

Descriptors: *Path of pollutants, *Sediment transport, *Sedimentation, *Sediment yield, *Erosion, *Rivers, *Soil loss, *Literature reviews, Lake sediments, Costs, Suspended sediment, Cropland, Sediment load, Particle size, Channel storage, Bed load, Sediment transport, Erosion control, Floods, Sediment distribution, Sediment erosion, Sediment sorting.

A review is presented that considers three foci of interest in the problem of erosion and sedimentation. (1) Sediment properties: The physical and chemical properties of fine-grained sediments are of growing interest in terms of the role of erosion in controlling the properties of sediment at source and the transport of particulates through river systems. This information is helpful in understanding nutrient and contaminant loads, interactions between particulate and dissolved phases, and the potential for preferential accumulation of nutrients and contaminants in depositional sinks. One study showed that the presence of aggregates within the detached material caused the eroded material to differ greatly in composition as compared with the parent soil. The storage and remobilization of sediment during movement through small drainage basins and large river systems are important in the study of transport of specific elements and organic substances (including pollutants) to the oceans. Physical and chemical properties of the sediments influence bioavailability, long-term fate and potential for interaction between particulate and soluble phases. Sediment composition in rivers does not always conform to the traditional assumption of increasing sand and decreasing clay content as discharge increases, as several examples show. Particle size of suspended sediment is also important for development and application of sediment routing models for river systems. Aggregation, common in rivers of high salinity, may also occur in rivers of low solute concentration. (2) Sediment storage in drainage basins: The sediment delivery ratio concept (sediment yield less than the gross erosion within the basin) is shown to have problems. Stored sediment can contribute to sediment yield in spite of improved erosion control. Channel storage of suspended sediment is also significant in downstream sediment yields. (3) Lake sediment studies have great potential for investigation of the environmental history of an upstream drainage basin. This is illustrated in studies of a small reservoir constructed in England in 1765, a larger lake in North Wales back to 1800, and a small lake in Sweden, which produced a sediment yield record of 5000 years. (Cassar-PTT)
W89-01015

ALLUVIAL CHANNEL HYDRAULICS,
P. Ackers.
Journal of Hydrology JHYDA7, Vol. 100, No. 1/3, p 177-204, July 30, 1988. 10 fig, 2 tab, 65 ref.

Descriptors: *Channel erosion, *Sediment transport, *Hydraulics, *Erosion, *Alluvial channels, *Literature reviews, Model studies, Channels, Vegetation effects, Bank erosion, Canals, Shear stress, Rivers, Floods, Gravel.

Utilization of alluvial channels requires an understanding of hydraulics and sediment transport. The regime of a conveyance channel in alluvium depends on the interrelationships of sediment transport, channel resistance, and bank stability. The regime concept was based on empirical relations obtained from observations from canal systems in India. Bed forms are classified into lower regime (ripples, dunes, and their combinations) and upper regime (flat bed and antidunes with surface waves). There is a transition between them as velocities increase. The empiricism of the original method has been replaced by process-based methods, which have also served as broad confirmation of the classic regime formulas, including their extension to natural channels and meandering channels. An alluvial channel typically has three degrees of freedom of adjustment (width, depth and slope), and thus three independent process equations are needed to provide a sound hydraulic design. Physical modeling using scale models of rivers and estuaries has been used for almost a century, but current knowledge of the physics of sediment transport and the complexity of alluvial channel roughness shows that these models can closely simulate the full-size condition only in very restricted circumstances. Computational models have been developed which avoid the scale effects. These are especially required where unsteady flows are to be simulated over a long time. Processes in which imperfect knowledge still hamper results include: (1) flood plain flows and their interaction with main channel flow; (2) stability problems in numerical models; (3) the influence of channel curvature on resistance and sediment transport; (4) sediment and flow distributions at channel branches; (5) the representation of non-steady conditions of transport; (6) armoring and sheltering and their influence on transport of graded sediments; (7) layering in the bed; (8) establishment of improved alluvial friction functions; (9) transition between lower and upper bed forms; (10) the influence of the proportion of fine material on sediment mobility; and (11) the economic extension of numerical methods to flows with significant three-dimensional aspects. (Cassar-PTT)
W89-01017

RECORDS OF RIVERBORNE TURBIDITY CURRENTS AND INDICATIONS OF SLOPE FAILURES IN THE RHONE DELTA OF LAKE GENEVA,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
A. Lambert, and F. Giovanoli.
Limnology and Oceanography LIOCAH, Vol. 33, No. 3, p 458-468, May 1988. 9 fig, 17 ref.

Descriptors: *Turbidity currents, *Slope degradation, *Lakes, *Deltas, Water currents, Lake Geneva, Channels, Topography, Rivers, Flow, Sediment transport, Current meters, Gages, Temperature, Flow discharge, Flow measurement.

The sublacustrine topography of the Rhone delta in Lake Geneva is characterized by a channel that can be traced about 9 km beyond the mouth of the river. Two instrumental moorings were deployed from June to August, 1985 in the channel axis at depths of 150 and 201 m to detect underflows of dense, sediment-laden river water. Each array consisted of three current meters and a thermistor chain. Data were recorded every 15 min (currents) or 30 min (temperatures). During 78 d of effective measurement, 31 well-defined downslope events were recorded, five with speeds > 50 cm/s. Major events correlate with discharge peaks of the Rhone, and current activity is characterized by single pulses lasting a few hours. Some flow events were accompanied by temperature increases of up to 3 C, suggesting two different current origins: the first is intrusion of sediment-laden, warm river water into the cold bottom water of the lake as a dense turbidity underflow, and the second is turbidity-current flow triggered by sliding or slumping of delta deposits. Damage caused to instruments and breakage of mooring links suggests sliding of large amounts of deltaic sediments or avalanche-like turbidity currents. (Author's abstract)
W89-01049

MEASUREMENT OF SHALLOW WATER WAVE DIRECTION FOR LONGSHORE SEDIMENT TRANSPORT,
London Univ. (England). Dept. of Geography.
J. Hardisty.
Geo Marine Letters GMLED1, Vol. 8, No. 1, p 35-39, 1988. 4 fig, 1 tab, 27 ref.

Descriptors: *Beaches, *Sediment transport, *Shallow water, *Wave direction, *Sand, *Longshore currents, *Hydrodynamics, Sedimentation, Mathematical analysis, Sediments.

Formulae which predict the longshore transport of sand under action of oblique waves are shown to be very sensitive to the angle of incidence of the waves. A simple, computerized wave recorder and pattern-matching technique is described which measures the angle of incidence by determining the phase difference between signals from a pair of closely spaced sensors. Data from field trials suggest that a resolution of better than 4 degrees is possible with this system, but problems of mixed frequency waves remain in both the longshore transport functions and the field equipment. (Author's abstract)
W89-01082

SEDIMENTS IN THE ESTUARINE ENVIRONMENT OF THE TIGRIS/EUPHRATES DELTA; IRAQ; ARABIAN GULF,
Basrah Univ. (Iraq). Marine Science Centre.
For primary bibliographic entry see Field 2L.
W89-01083

SEDIMENTARY ENVIRONMENTS AND FACIES OF THE SUBTROPICAL MGENI ESTUARY, SOUTHEAST AFRICA,
National Inst. for Water Research, Congella (South Africa). Natal Regional Lab.
For primary bibliographic entry see Field 2L.
W89-01084

SEDIMENT TRANSPORT OF THE GODAVARI RIVER BASIN AND ITS CONTROLLING FACTORS,
Jawaharlal Nehru Univ., New Delhi (India). School of Environmental Sciences.

G. Biksham, and V. Subramanian.
Journal of Hydrology JHYDA7, Vol. 101, No. 1-4, p 275-290, June 30, 1988. 7 fig, 9 tab, 35 ref.

Descriptors: *Godavari River, *Sediment transport, *Streamflow, *Stream erosion, *Sediment load, *India, Silt, Clays, Suspended sediments, Sediment discharge, Geology, River basins.

The mean annual water flow and sediment transport of the Godavari River are estimated to be 92 cu km and 170 million tons, respectively. In terms of sediment transport and the rate of physical erosion (555 tons/square km/yr), the position of the Godavari would be ninth and fifth, respectively, among the world rivers. Geology of the basin is the main controlling factor of the sediment transport. The sedimentary rocks located in the lower part of the basin and constituting 7% of the total basin area are responsible for 33% of the sediment load. More than 67% of sediment load is silt and clay. Annual, monthly and daily variations in sediment transport indicate that a few selected days in the hydrological year control the annual sediment budget. Latest estimates are nearly twice those of earlier values. The presently available global estimates on sediment transport need to be re-evaluated. (Author's abstract)
W89-01211

2K. Chemical Processes

INTERNAL ELEMENTAL CYCLES AFFECTING THE LONG-TERM ALKALINITY STATUS OF LAKES: IMPLICATIONS FOR LAKE RESTORATION,
Freshwater Biological Association, Windermere (England).
For primary bibliographic entry see Field 5G.
W89-00016

ROLE OF EXTERNAL AMMONIUM INPUTS IN FRESHWATER ACIDIFICATION,
Katholieke Univ. Nijmegen (Netherlands). Lab. of Aquatic Ecology.
For primary bibliographic entry see Field 5B.
W89-00024

CONCERNING CERTAIN STUDIES ON SEEPAGE AND DISSOLUTION OF SALTS IN THE FOUNDATION OF DAMS,
For primary bibliographic entry see Field 10C.
W89-00062

CHEMISTRY OF ATMOSPHERIC PRECIPITATION IN THE BABIA GORA NATIONAL PARK,
Polish Academy of Sciences, Krakow. Zaklad Ochrony Przyrody i Zasobow Naturalnych.
For primary bibliographic entry see Field 5B.
W89-00082

NEW ASPECTS OF THE SULFUR CYCLE, WITH SPECIAL REFERENCE TO SHALLOW WATERS,
Hajdu-Bihar County Water Canalization Works, Debrecen (Hungary).
For primary bibliographic entry see Field 5B.
W89-00183

DYNAMICS OF IRON AND MANGANESE IN THE SURFACE SEDIMENTS OF A SEASONALLY ANOXIC LAKE,
For primary bibliographic entry see Field 2H.
W89-00188

PRELIMINARY STUDY ON THE MIGRATION AND TRANSFORMATION OF HEAVY METALS IN THE SEWAGE-SEAWATER MIXING ZONE OF JINZHOU BAY, (IN CHINESE),
Institute of Marine Environmental Protection, Dalian (China).
For primary bibliographic entry see Field 5B.
W89-00199

CHEMICAL BEHAVIOR OF METAL ELEMENTS IN THE SEDIMENTS IN THE HANJIANG RIVER ESTUARY AND SHANTOU PORT, (IN CHINESE),
Academia Sinica, Guangzhou (China). South China Sea Inst. of Oceanology.
For primary bibliographic entry see Field 2L.
W89-00202

SOIL PROCESSES AND SULFATE LOSS AT THE HUBBARD BROOK EXPERIMENTAL FOREST,
Maine Univ., Orono. Dept. of Geological Sciences.
For primary bibliographic entry see Field 5B.
W89-00206

CYCLING OF INORGANIC AND ORGANIC SULFUR IN PEAT FROM BIG RUN BOG, WEST VIRGINIA,
Villanova Univ., PA. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W89-00208

INFLUENCE OF THE VISTULA RIVER ON DISTRIBUTION OF 226RA IN THE GDANSK BAY,
Polish Academy of Sciences, Sopot. Inst. of Oceanology.
G. Kowalewska.
Polskie Archiwum Hydrobiologii PAHYA2, Vol. 34, No. 1, p 1-6, 1987. 1 fig, 3 tab, 13 ref.

Descriptors: *Poland, *Geochemistry, *Vistula River, *Gdansk Bay, *Radium radiosotopes, *Solute transport, *Isotope studies, Regional analysis, Rivers, Chemical analysis, Water chemistry.

Distribution of 226Ra in waters of the Gdansk Bay in the years 1983-1984, was investigated. The emanation method was used to determine 226Ra activity in the water samples. Activity of 226Ra increased from the mouth of the river to the Deep of Gdansk. There is probable, though not high, release of the isotope from the river-borne suspended matter entering the salinity gradient. 226Ra concentration in the Vistula water (1.0 mBq/cu dm), typical of rivers in the world (0.7-1.7 mBq/cu), was lower than that in the Bay water (1.5 and 1.9 mBq/cu m at surface and bottom respectively). The Vistula discharges about 1 g/yr of 226Ra, which is 6% of 226Ra content in the Gdansk Bay waters and 0.1% of 226Ra content in the whole Baltic Waters, according to estimates. (Author's abstract)
W89-00250

CHEMICAL MECHANISMS OF HEAVY METAL TRANSPORT IN WATERS OF MALA PANEW AND BRYNICA RIVERS (SILESIA, POLAND),
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5B.
W89-00251

MICROBIALLY MEDIATED MN(II) OXIDATION IN AN OLIGOTROPHIC ARCTIC LAKE,
Alaska Univ., Fairbanks. Inst. of Marine Science.
For primary bibliographic entry see Field 2H.
W89-00335

PHOTOEXCRETION AND FATE OF GLYCOLATE IN A HOT SPRING CYANOBACTERIAL MAT,
Montana State Univ., Bozeman. Dept. of Microbiology.
For primary bibliographic entry see Field 2H.
W89-00342

EFFECTS OF SEDIMENT NUTRIENTS ON SEAGRASSES: LITERATURE REVIEW AND MESOCOSM EXPERIMENT,
New Hampshire Univ., Durham. Jackson Estuarine Lab.
For primary bibliographic entry see Field 2L.
W89-00523

APPLICATION OF THE PRINCIPLE OF LEAST SIGMA TO THE CHEMICAL MODEL OF NATURAL WATER, (IN CHINESE),
Chinese Academy of Environmental Sciences, Beijing.
For primary bibliographic entry see Field 2H.
W89-00537

BORON LEVELS IN SOME GROUND WATERS OF HALKIDIKI (A LAND AT NORTHERN AEGEAN SEA),
Thessaloniki Univ., Salonika (Greece). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-00569

LEACHING OF MERCURY FROM PEAT SOIL,
Helsinki Univ. (Finland). Dept. of Environmental Science.
For primary bibliographic entry see Field 5B.
W89-00592

BIOGEOCHEMISTRY OF BENZ(A)ANTHRACENE AT THE SEDIMENT-WATER INTERFACE,
Massachusetts Univ. at Boston. Environmental Science Program.
For primary bibliographic entry see Field 5B.
W89-00612

EFFECT OF PH AND CONTACT TIME ON THE CONCENTRATION OF AS(III) AND AS(V) IN COAL ASH SYSTEMS,
Georgia Univ., Sapelo Island. Marine Inst.
For primary bibliographic entry see Field 5E.
W89-00624

PHYSICAL AND CHEMICAL CHARACTERISTICS OF THE WATERS OF THE BOT RIVER ESTUARY, SOUTH AFRICA,
Cape Town Univ. (South Africa). Dept. of Zoology.
For primary bibliographic entry see Field 2L.
W89-00655

EFFECT OF SALINITY AND TEMPERATURE VARIATIONS ON THE BACTERIAL POPULATION IN THE BOT RIVER ESTUARY,
Cape Town Univ. (South Africa). Dept. of Zoology.
For primary bibliographic entry see Field 2L.
W89-00657

CA(+2)-STRESS, BIOLOGICAL RESPONSE AND PARTICLE AGGREGATION IN THE AQUATIC HABITAT,
Hamburg Univ. (Germany, F.R.). Geologisch-Palaeontologisches Inst. und Museum.
E. T. Degens, and V. Ittekkot.
Netherlands Journal of Sea Research NJSRBA, Vol. 20, No. 2/3, p 109-116, August 1986. 6 fig, 3 tab, 46 ref.

Descriptors: *Organic compounds, *Aquatic environment, *Calcium, *Geochemistry, *Biochemistry. Ions, Cations, Chemical properties.

Experimental data from a fresh water environment, a coastal environment and an open ocean environment were examined to pinpoint areas where the role of Ca(+2) organic interactions may be significant. The results showed that: (1) at certain levels, Ca(+2) becomes toxic in the sense that it will interfere with normal functioning of the cell, (2) mechanisms exist to detoxify Ca(+2) in the aquatic environment, and (3) organisms have developed adequate counteracting devices by which Ca(+2) is kept at optimal levels within the cell. The three sets of data presented indicate that Ca(+2) participates in various ways in the release and concentration of organic matter. Release of Ca(+2) binding protein is a cellular response to increased Ca(+2) in the environment. In samples from the coastal sea, Ca(+2) binding organic matter is functional in the formation of foam, probably by enrichment

processes involving bubbles. In the open sea, Ca(+2) organic interactions lead to the formation of stable macroaggregates. Thus, Ca(+2) organic interactions appear to be integrators not only in biological systems but also in geochemical systems. (Miller-PTT)
W89-00669

FLOCCULATION AND DE-FLOCCULATION OF SUSPENDED MATTER IN ESTUARIES,
Nederlands Inst. voor Onderzoek der Zee, Texel.
For primary bibliographic entry see Field 2L.
W89-00671

DYNAMICS OF DISSOLVED SILICIUM AND NITROGEN-NUTRIENTS AT LOW TEMPERATURE IN THE EMS-DOLLARD ESTUARY,
Nederlands Inst. voor Onderzoek der Zee, Texel.
For primary bibliographic entry see Field 2L.
W89-00673

IRON OXIDE FORMATION IN ARTIFICIAL GROUND WATERS,
Technische Univ. Muenchen (Germany, F.R.). Lehrstuhl fuer Bodenkunde.
For primary bibliographic entry see Field 2F.
W89-00687

CAN THE REDOX CONDITIONS IN NATURAL WATERS BE PREDICTED BY A SINGLE PARAMETER,
Bayreuth Univ. (Germany, F.R.).
T. Frevert.
Schweizerische Zeitschrift fuer Hydrologie SZHYA6, Vol. 46, No. 2, p 269-290, June 1984. 4 fig, 4 tab, 45 ref.

Descriptors: *Chemical properties, *Water chemistry, *Natural waters, *Oxidation-reduction potential, *Oxidation, *Water properties, *Electrochemistry, Chemical reactions, Prediction, Lake Kinneret, Israel, Electron transfer, Sediment-water interfaces.

The thermodynamic p-epsilon (redox potential) is the theoretical master variable of the ultimate redox conditions in aqueous solutions. Real multicomponent redox processes, however, cannot be predicted by redox potential considerations alone. In such cases, a detectable notion, the operational parameter pe, has to be introduced, which is defined by the response of an adequate sensor to redoxchemical changes in natural extracellular systems. The solution/sensor interaction is described by the general theory of stationary states and, in case of Pt metal as sensor, by the electronic equilibrium of Pt in aqueous solutions. Examples of pe/dissolved oxygen feedback control experiments with sediment-water systems from Lake Kinneret indicate that redox potential is dependent on the electron donator and the electron acceptor, thus being predictive of the real electron transfer reactions. (See also W89-00689) (Author's abstract)
W89-00688

INTERPRETATION AND MEASUREMENT OF REDOX INTENSITY IN NATURAL WATERS: A COMMENT TO T. FREVERT'S PAPER, 'CAN THE REDOX CONDITIONS IN NATURAL WATERS BE PREDICTED BY A SINGLE PARAMETER',
Eidgenoessische Technische Hochschule, Zurich (Switzerland).
W. Stumm.
Schweizerische Zeitschrift fuer Hydrologie SZHYA6, Vol. 46, No. 2, p 291-296, June 1984. 4 fig, 1 tab, 8 ref.

Descriptors: *Chemical properties, *Chemical reactions, *Water chemistry, *Oxidation-reduction potential, *Oxidation, *Water properties, *Electrochemistry, Heavy metals, Electrical studies, Equilibrium.

Frevert proposed, for equilibrium systems, a distinction between a conceptually defined redox intensity, P-epsilon, and an operationally defined redox condition under stationary states, pe, as given by the response of a sensor electrode, and that pe need not related to pe re-emphasized that, in defining a redox intensity, pe=log(e), Stumm treated the electron conceptually as a basic redox component which, as a species in aqueous solution, does not have an existence of its own. Morel has elaborated on the use of the electron as a (phase rule) component in redox reactions. As he shows, it obviously can be treated equivalent to O2, i.e., 02 = H(+) sub (-4) (e)(-) sub (-4) H202. Pepsilon was defined previously as 'the hypothetical electron activity at equilibrium that measures the relative tendency of a solution to accept or transfer electrons.' This free energy change delta(G) can be expressed as a redox potential (electrode potential) in volts (i.e., as a free energy change per mole of electrons associated with a given reduction). Electron activities may be defined in any equilibrium systems where the free activities of reductants (Red), and oxidants (Ox), are defined. Thus, pepsilon (like pH) is a derivative form of free energy. Using electrons in redox reactions and as components does not at all imply that such electrons exist as species in waters. Sillen and Martell treated the electron as an inorganic ligand and established an electron activity scale that corresponds to the definition given. (See also W89-00688) (Author's abstract)
W89-00689

DEGRADATION AND FORMATION OF REFRACTORY DOM BY BACTERIA DURING SIMULTANEOUS GROWTH ON LABILE SUBSTRATES AND PERSISTENT LAKE WATER CONSTITUENTS,
Konstanz Univ. (Germany, F.R.). Limnological Inst.
For primary bibliographic entry see Field 2H.
W89-00691

INTERPRETATION OF METAL PROFILES IN A SEDIMENT CORE FROM LAKE GENEVA: METAL MOBILITY OR POLLUTION,
Academia Sinica, Beijing (China). Inst. of Environmental Chemistry.
For primary bibliographic entry see Field 5B.
W89-00694

ROLE OF CHEMICAL WEATHERING IN THE NEUTRALIZATION OF ACIDIC DEPOSITION,
Iowa Univ., Iowa City. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W89-00696

DRAINAGE BASIN CONTROL OF ACID LOADINGS TO TWO ADIRONDACK LAKES,
Clarkson Univ., Potsdam, NY. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W89-00710

ALKALINITY REGULATION IN SOFTWATER FLORIDA LAKES,
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
For primary bibliographic entry see Field 2H.
W89-00714

THEORETICAL EVALUATION OF WATER OLIGOMER POPULATIONS IN THE EARTH'S ATMOSPHERE,
Hokkaido Univ., Sapporo (Japan). Dept. of Chemistry.
For primary bibliographic entry see Field 2B.
W89-00763

WET DEPOSITION OF AMMONIUM IN EUROPE,
Utrecht Rijksuniversiteit (Netherlands). Inst. voor Meteorologie en Oceanografie.
For primary bibliographic entry see Field 2B.
W89-00765

RECENT TRANSPORT OF METALS IN THE RIVER SEVERN AS RECORDED BY THE SEDIMENTS OF CHELMARSH RESERVOIR, SHROPSHIRE, U.K.,
Exeter Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 5B.
W89-00885

CHEMISTRY AND DELTA 13C OF TOTAL DISSOLVED CARBON IN WATERS OF SELECTED SPRINGS NEARBY LUBLIN CITY: WEEKLY OBSERVATIONS FROM OCTOBER 1982 TO JUNE 1983,
Marie Curie-Sklodowska Univ., Lublin (Poland).
For primary bibliographic entry see Field 2F.
W89-00895

PRODUCTIVITY AND NUTRIENT CYCLING OF ALASKAN TUNDRA: ENHANCEMENT BY FLOWING SOIL WATER,
Alaska Univ., Fairbanks. Inst. of Arctic Biology.
For primary bibliographic entry see Field 2G.
W89-00908

DEFINITION OF A MODEL FOR MONITORING THE CHEMICAL AND CHEMICAL-PHYSICAL CHARACTERISTICS OF DEEP DRINKING WATERS,
Perugia Univ. (Italy). Cattedra di Igiene.
For primary bibliographic entry see Field 7C.
W89-00927

MULTISIGNAL AUTOMATIC CALIBRATION METHODOLOGY FOR HYDROCHEMICAL MODELS: A CASE STUDY OF THE BIRKENES MODEL,
Ontario Ministry of the Environment, Dorchester. Dorset Research Center.
For primary bibliographic entry see Field 5B.
W89-00973

TRANSMISSION ELECTRON MICROSCOPIC STUDY OF SOLIDIFIED/STABILIZED ORGANICS,
Louisiana State Univ., Baton Rouge. Hazardous Waste Research Center.
For primary bibliographic entry see Field 5E.
W89-01000

MANGANESE OXIDATION IN PH AND O2 MICROENVIRONMENTS PRODUCED BY PHYTOPLANKTON,
Wisconsin Univ., Milwaukee. Center for Great Lakes Studies.
L. L. Richardson, C. Aguilar, and K. H. Nealson.
Limnology and Oceanography LIOCAH, Vol. 33, No. 3, p 352-363, May 1988. 8 fig, 1 tab, 28 ref. NASA Grant NAGW1047; Milwaukee Shaw Foundation and NASA Grant NCC 2-369.

Descriptors: *Limnology, *Oxidation-reduction potential, *Manganese, *Acidity, *Phytoplankton, *Biotransformation, Oxidation, Oxygen, Photosynthesis, Lakes, Algae, Chlorella, Chlorophyta, Hydrogen ion concentration, Chemical properties, Metabolism, Cyanophyta, Microcystis, Glucose.

Pure cultures of Chlorella sp. isolated from Oneida Lake, NY were found to catalyze the oxidation of soluble Mn(II) to particulate, extracellular, manganic oxides. Manganese oxidation was dependent on photosynthetic activity. Manganates were not formed when media were buffered below pH 8.0, suggesting that an important driving force for manganese oxidation was the high pH resulting from photosynthesis. Field studies with minielectrodes in Oneida Lake demonstrated steep gradients of O2 and pH in the presence of particulate manganic oxides associated with pelagic aggregates of the cyanobacterium Microcystis sp. The manganese oxidation reaction apparently occurs only when photosynthesizing algae are present as dense populations that can generate microenvironments of high (> 9.0) pH, either as aggregates in the pelagic zone or concentrated cell cultures in the laboratory. A large-scale transition from soluble to particulate manganese was measured in the surface waters of Oneida Lake throughout summer 1986. Remov-

al of Mn(II) was correlated with the presence of aggregate-forming cyanobacteria that oxidize Mn(II) by the mechanism described above. (Author's abstract)
W89-01045

PATTERNS OF SULFATE REDUCTION AND THE SULFUR CYCLE IN A SOUTH CAROLINA SALT MARSH,
Maine Univ., Walpole. Ira C. Darling Center for Research, Teaching and Service.
G. M. King.
Limnology and Oceanography LIOCAH, Vol. 33, No. 3, p 376-390, May 1988. 8 fig, 2 tab, 55 ref. NSF Grant BSR 83-0303; NASA Grant NAGW-607.

Descriptors: *Salt marshes, *Sulfates, *Seasonal variation, *Sulfur cycle, Marshes, Nutrients, South Carolina, Sediments, Spartina, Cycling nutrients, Temperature, Productivity, Sulfides, Chemical reactions, Oxidation, Chromium, Sulfur, Tides, Oxygen.

Rates of sulfate reduction and the magnitude of various sediment parameters related to the sulfur cycle were measured at about quarterly intervals for a 3-yr period at sites in a South Carolina salt marsh containing tall- or short-form Spartina alterniflora. Sulfate reduction rates were greater at all times in the short-form sites and decreased markedly with depth. Seasonal changes were highly correlated with ambient temperature except in May and August when interactions with plants may have affected rates directly. In the short-form site, the annual integrated sulfate reduction rate accounted for about 47.5-67.0% of the estimated belowground plant production. Dissolved sulfides and pH varied seasonally in the short- but not tall-form sites; seasonal minima in the short-form site occurred during May and were probably due to oxidation of the sediment with the onset of plant production. (Author's abstract)
W89-01046

ALUMINUM SPECIATION IN SURFACE WATERS FROM A WELSH UPLAND AREA,
University Coll. of Swansea (Wales). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5B.
W89-01055

VARIABILITY OF DISSOLVED TRACE METALS IN THE MISSISSIPPI RIVER,
Massachusetts Inst. of Tech., Cambridge. Dept. of Earth, Atmospheric and Planetary Sciences.
For primary bibliographic entry see Field 5B.
W89-01075

ARAGONITE-TO-CALCITE TRANSFORMATION DURING FRESH-WATER DIAGENESIS OF CARBONATES: INSIGHTS FROM PORE-WATER CHEMISTRY,
Colorado Univ. at Boulder. Dept. of Geological Sciences.
D. A. Budd.
Geological Society of America Bulletin BUGMA, Vol. 100, No. 8, p 1260-1270, August 1988. 13 fig, 2 tab,58 ref. National Science Foundation Grant EAR-8001650.

Descriptors: *Diagenesis, *Geohydrology, *Interstitial water, *Sand, *Carbonate rocks, *Hydrologic cycle, Calcite, Aragonite, Calcium, Strontium, Limestone, Meteoric water, Mass transfer, Bahamas, Water chemistry.

Dissolved strontium and calcium concentrations in fresh-water lenses (FWL) and associated mixing zones (MZ) on two small, Holocene ooid-sand islands in the Schooner Cays, Bahamas, were monitored during a 1-yr period to quantitatively analyze the transformation of aragonite to calcite. The observed characteristics of this mass transfer are functions of climate and hydrology. Aragonite-to-calcite transformation in all hydrologic zones is primarily associated with meteoric recharge. The transformation occurs throughout the FWL and in the MZ to relative salinities of 19% and 36% sea water on the 2 islands. Rates of transformation are rapid in all zones and are greatest in the FWL. A limestone composed of 100% calcite should form from an aragonite precursor within 4,777 to 15,666 yr in the FWL, and within 8,700 to 60,000 yr in the upper MZ. Efficiencies of transformation can vary between hydrologic zones due to PCO2 effects; yet, the efficiency of the entire system (FWL + MZ) is high (87%). This indicates that most CaCO3 derived from aragonite dissolution is reprecipitated as calcite somewhere in the fresh-water system or upper mixing zone. CO2 effects, fresh-water-sea-water mixing, and the differing solubilities between aragonite and calcite all drive the mass transfer. The differing solubilities is the most significant, accounting for up to 9 times more mass transfer than CO2 effects and at least 10 times more mass transfer than fresh-water-sea-water mixing. Differing solubilities should also cause mass transfer to occur throughout the hydrologic cycle, but it apparently becomes ineffective after the rainy season, possibly due to the inhibition of calcite precipitation. (Author's abstract)
W89-01076

COPPER BINDING BY DISSOLVED ORGANIC MATTER: I. SUWANNEE RIVER FULVIC ACID EQUILIBRIA,
North Carolina Univ., Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5B.
W89-01077

COPPER BINDING BY DISSOLVED ORGANIC MATTER: II. VARIATION IN TYPE AND SOURCE OF ORGANIC MATTER,
North Carolina Univ., Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5B.
W89-01078

TRACE METAL GEOCHEMISTRY OF PORE WATER BRINES FROM TWO HYPERSALINE LAKES,
New Hampshire Univ., Durham. Inst. for the Study of Earth, Oceans and Space.
W. B. Lyons, M. J. Spencer, M. E. Hines, and H. E. Gaudette.
Geochimica et Cosmochimica Acta GCACAK, Vol. 52, No. 2, p 265-274, February 1988. 5 fig, 7 tab, 96 ref.

Descriptors: *Geochemistry, *Trace metals, *Interstitial water, *Lakes, *Salinity, *Brines, *Sediments, Sediment-water interfaces, Surface water, Metals, Lead, Zinc, Copper, Chemical analysis.

Pore water brines from modern hypersaline lake sediments were analyzed to determine the nature of brine-trace metal interaction in these environments. Brines samples were collected from the surface waters and sedimentary pore waters of two hypersaline lakes; Solar Lake, eastern Sinai, and Goto Meer, Bonaire, Netherlands Antilles. Metal concentrations in the oxic brines appear to be related to the strength of their respective chloride complexes, with Pb and Zn more enriched than Cu. Pore water Cu, Zn, and Fe concentrations increased across the sediment-water interface in both lakes. All three metal profiles follow a similar pattern with depth in the pore water. Higher concentrations were observed in the Goto Meer brines. Strontium isotopes were utilized to qualify better the mixing of the brines in Solar Lake. Although these metals were observed at higher concentrations than sea water in the sulfidic brines, their concentrations are not close to what is needed for the formation of ore deposits. (Author's abstract)
W89-01079

SURFACE REACTIONS OF SYNTHETIC, END-MEMBER ANALOGUES OF MONAZITE, XENOTIME AND RHABDOPHANE, AND EVOLUTION OF NATURAL WATERS,
McMaster Univ., Hamilton (Ontario). Dept. of Geology.
R. G. Jonasson, G. M. Bancroft, and L. A. Boatner.
Geochimica et Cosmochimica Acta GCACAK, Vol. 52, No. 3, p 767-770, March 1988. 1 fig, 1 tab, 8 ref.

Descriptors: *Water chemistry, *Weathering, *Carbonates, *Sulfates, *Chemical reactions, *Rare earth elements, Monazite, Xenotime, Rhabdophane, Ion exchange, Natural waters, Solubility.

Evidence has accumulated that certain carbonate and sulfate minerals undergo selective surface ion-exchange reactions with aqueous solutions at low temperatures. Evidence obtained by powder XRD, SIMS and XPS is presented indicating that synthetic rare earth element (REE) phosphate mineral analogues undergo similar reactions. Hydrous Hoxenotime reacts with aqueous Nd3+ over a period of months to produce Nd-rhabdophane. Sm- and Nd- monazite crystals undergo detectable surface exchange reactions within 5 days at 65 degrees centigrade. Ho- and Er-xenotime react similarly. Exchange of Y and Lu in the surface layers of Luxenotime is pH dependent, with lower pH favoring replacement. Clearly, such effects are relevant to the debate about REE concentrations and signatures in natural waters, particularly in view of the widespread occurrence of monazite in nature. (Author's abstract)
W89-01080

SOLUBILITY OF COLLOIDAL FERRIC HYDROXIDE AND ITS RELEVANCE TO IRON CONCENTRATIONS IN RIVER WATER,
Harvard Univ., Cambridge, MA. Div. of Applied Sciences.
L. E. Fox.
Geochimica et Cosmochimica Acta GCACAK, Vol. 52, No. 3, p 771-777, March 1988. 2 fig, 3 tab, 40 ref. NSF Grant BSR-83-16359 and EPA Grant R810210-01-0.

Descriptors: *Solubility, *Colloids, *Iron, *Water chemistry, *Atomic absorption spectrophotometry, Hydrogen ion concentration, Delaware River, Particulate matter, Dialysis, Ferric hydroxide, Rivers.

Concentrations of dissolved iron in equilibrium with colloidal ferric hydroxide were experimentally determined by dialysis followed by atomic absorption spectroscopy. The results were compared to values obtained from the literature. The referenced values were determined by electrochemical methods under a wide variety of experimental conditions which necessitated corrections for the presence of ferric complexes and for variations in ionic strengths. The mass action equation (given) is proposed to represent the solubility of aqueous ferric hydroxide colloids. Published data from rivers, corrected from imcomplete separation of colloidal from dissolved iron and, dialyzed samples of Delaware River water with pH values adjusted to range between 5 and 8 were fit to the solubility equation. Both sources of evidence demonstrated concentrations of dissolved iron to be near saturation with colloidal ferric hydroxide. (Author's abstract)
W89-01081

REACTIVITY OF THE CARBONATE RADICAL WITH ANILINE DERIVATIVES,
Environmental Protection Agency, Athens, GA. Southeast Environmental Research Lab.
For primary bibliographic entry see Field 5B.
W89-01088

OZONE-INDUCED PARTICLE DESTABILIZATION,
Stevens Inst. of Tech., Hoboken, NJ. Dept. of Civil and Ocean Engineering.
For primary bibliographic entry see Field 5F.
W89-01120

ROLE OF SOIL ORGANIC MATTER IN THE GEOCHEMICAL CYCLING OF CHLORIDE AND BROMIDE,
Commonwealth Scientific and Industrial Research Organization, Wembley (Australia). Div. of Water

Resources.
For primary bibliographic entry see Field 2A.
W89-01200

RELATIONSHIP BETWEEN GLACIAL GEOLOGY AND STREAMWATER CHEMISTRY IN AN AREA RECEIVING ACID DEPOSITION,
State Univ. of New York at Buffalo. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5B.
W89-01210

CHEMICAL EVOLUTION OF A TRAVERTINE-DEPOSITING STREAM: GEOCHEMICAL PROCESSES AND MASS TRANSFER REACTIONS,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
M. M. Lorah, and J. S. Herman.
Water Resources Research WRERAO, Vol. 24, No. 9, p 1541-1552, September 1988. 8 fig, 5 tab, 40 ref. U.S./Spain Joint Committee for Scientific and Technological Cooperation Grant 83-007.

Descriptors: *Streams, *Geochemistry, *Travertine, *Deposition, Chemical reactions, Virginia, Carbon dioxide, Calcite, Chemical precipitation, Computer models, Stream discharge, Supersaturation, Photosynthesis, Waterfalls, Rapids, Turbulence, Low flow.

A field study focused on quantitatively defining the chemical changes occurring in Falling Spring Creek, a travertine-depositing stream located in Alleghany County, Virginia. The processes of CO2 outgassing and calcite precipitation or dissolution controlled the chemical evolution of the stream. The observed chemical composition of the water was used with the computerized geochemical model WATEQF to calculate aqueous speciation, saturation indices, and CO2 partial pressure values. Mass-balance calculations were performed to obtain mass transfers of CO2 and calcite. Reaction times, estimated from stream discharge, were used with the mass-transfer results to calculate rates of CO2 outgassing and calcite precipitation between consecutive sampling points. The stream, which is fed by a carbonate spring, is supersaturated with respect to CO2 along the entire 5.2-km flow path. Outgassing of CO2 drives the solution to high degrees of supersaturation with respect to calcite. Metabolic uptake of CO2 by photosynthetic plants is insignificant, because the high supply rate of dissolved CO2 and the extreme agitation of the stream at waterfalls and rapids causes a much greater amount of inorganic CO2 outgassing to occur. Calcite precipitation is kinetically inhibited until near the crest of a 20-m vertical waterfall. Calcite-precipitation rates then reach a maximum at the waterfall where greater water turbulence allows the most rapid escape of CO2. Physical evidence for calcite precipitation exists in the travertine deposits which are first observed immediately above the waterfall and extend for at least 1.0 km below the falls. Net calcite precipitation occurs at all times of the year but is greatest during low-flow conditions in the summer and early fall. (Author's abstract)
W89-01250

2L. Estuaries

PHYTOPLANKTON COMPOSITION OF STAGNANT AND TIDAL ECOSYSTEMS IN RELATION TO SALINITY, NUTRIENTS, LIGHT AND TURBULENCE,
Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
J. W. Rijstenbil.
Netherlands Journal of Sea Research NJSRBA, Vol. 21, No. 2, p 113-123, June 1987. 11 fig, 1 tab, 48 ref.

Descriptors: *The Netherlands, *Deltas, *Estuaries, *Brackish water, *Lakes, *Phytoplankton, Diatoms, Flagellates, Algae, Chlorophyta, Species distribution, Salinity, Nutrients, Turbulent flow, Light intensity, Eutrophication, Ammonium, Nitrates, Nitrogen, Seasonal variation, Saline lakes, Stagnant water, Limnology, Salinity, Limiting nutrients.

One of the main characteristics of the Delta area in the southwestern Netherlands is the wide variety of brackish water types. Phytoplankton developments were compared in a small mesohaline and polyhaline lake, and in a mesohaline and polyhaline part of an open estuary. Salinity differences affected phytoplankton distribution. This was most evident in diatoms of marine origin. In the mesohaline waters relatively euryhaline marine species of diatoms were found: Skeletonema costatum in all water types, and Actinocyclus ehrenbergii only in the estuary. Thalassiosira nordenskioldii and Ditylum brightwellii showed some tolerance to a mesohaline environment. Detonula delicatula and Rhizosolenia delicatula were limited to the polyhaline waters. Both the relative abundance and the mean size of the diatoms increased with the degree of turbulence in the systems, which was low (except in the early spring) in the lakes, but high in the tidal system. In spring, diatom blooms were a regular phenomenon in the mesohaline and polyhaline lakes. Ammonium was depleted during the diatom blooms in spring. Nitrate was depleted by flagellates, small diatoms, and green algae in the top of the photic zone of the lakes. As a result, nitrogen was limiting phytoplankton growth in summer and in autumn. At the estuarine locations large diatoms were found to be suspended in the completely mixed water column. (Author's abstract)
W89-00001

DISTRIBUTION, DYNAMICS AND PRODUCTIVITY OF A COLONIZING (POLYDORA QUADRILOBATA) AND AN ESTABLISHED (P. LIGNI) POLYDORID POLYCHAETE IN LAKE GREVELINGEN: AN ENCLOSED ESTUARY IN THE SW NETHERLANDS,
Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
For primary bibliographic entry see Field 2H.
W89-00002

SUSPENDED MATTER AND BOTTOM DEPOSITS IN THE MAHURY ESTUARINE SYSTEM (FRENCH GUIANA): ENVIRONMENTAL CONSEQUENCES,
Institut de Geologie du Bassin d'Aquitaine, Talence (France).
For primary bibliographic entry see Field 2J.
W89-00003

AVAILABILITY OF PHOSPHORUS SOURCES FOR BLOOMS OF PHAEOCYSTIS POUCHETII (HAPTOPHYCEAE) IN THE NORTH SEA: IMPACT OF THE RIVER RHINE,
Nederlands Inst. voor Onderzoek der Zee, Texel.
M. J. W. Veldhuis, L. A. H. Venekamp, and T. Ietswaart.
Netherlands Journal of Sea Research NJSRBA, Vol. 21, No. 3, p 219-229, September 1987. 9 fig, 2 tab, 36 ref.

Descriptors: *Coastal waters, *North Sea, *Algal growth, *Eutrophication, *Phytoplankton, *Phosphorus, Phosphates, Orthophosphates, Enzymes, Alkaline phosphatase, Organic compounds, Rhine River, Water pollution sources, Nutrients, Limiting nutrients, Isotope studies, Radioactive tracers, Aquatic bacteria.

The distribution and uptake of various phosphorus fractions such as soluble reactive phosphorus (SRP), enzymatically hydrolyzable phosphorus (EHP) and soluble unhydrolzsable phosphorus were studied in coastal waters of the North Sea with special emphasis on those areas inhabited by dense blooms of Phaeocystis pouchetii. A comparison was made between the uptake rates of SRP and the capacity of the phytoplankton to utilize the EHP fraction as a phosphorus source. In areas not directly influenced by the discharge of the River Rhine the phytoplankton depleted the SRP down to the detection level of 0.02 micromole/cu dm, while the concentration of EHP was always higher. Inorganic phosphate (SRP) was rapidly assimilated by the microplankton (algae and bacteria) as measured by the uptake of P32-orthophosphate. Concurrently, the alkaline phosphatase activity (APA) was high and appeared to be associated mainly with the phytoplankton. Various measurements indicated that the plankton was P-limited. The calculated rate of enzymatic hydrolysis of EHP was highly variable, but could provide the cells with orthophosphate at a rate comparable with that measured for the direct uptake of inorganic phosphate. The diversity and availability of phosphate sources in the area near the Rhine varied strongly. The abundant supply of phosphorus by the river to the coastal waters can cause further growth of the phytoplankton, unrestricted by nutrient limitation. Here it seemed that EHP and APA played only an insignificant role. The dominance of Phaeocystis in these coastal waters is discussed in view of its capacities to exploit transient phosphate supply. (Author's abstract)
W89-00004

EFFECTS OF RIVER DISCHARGE AND VERTICAL CIRCULATION ON AQUATIC PRIMARY PRODUCTION IN A TURBID LOUISIANA (USA) ESTUARY,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
J. M. Randall, and J. W. Day.
Netherlands Journal of Sea Research NJSRBA, Vol. 21, No. 3, p 231-242, September 1987. 4 fig, 4 tab, 49 ref.

Descriptors: *Estuaries, *Aquatic productivity, *Primary productivity, *River flow, Water circulation, Discharge, Spatial distribution, Seasonal distribution, Salinity, Sampling, *Turbidity, Limiting nutrients, Light penetration, Fourleague Bay, Louisiana.

Aquatic primary production was measured in stationary and moving bottles with the light/dark oxygen method at 2 sites in Fourleague Bay, a shallow, turbid estuary on the central Louisiana coast receiving flow from the Atchafalaya River. River flow strongly influenced spatial and seasonal patterns of production. Annual net production increased from 382.5 g O2 /sq m (119.5 g C/sq m) at an upper bay site near the river mouth to 1015.7 g O2/sq m (317.4 g C/sq m) at a lower bay site distant from the river. Net production was negatively correlated with seasonal changes in river flow at both sites. Maximum production rates occurred at intermediate salinities. At low salinities, production was apparently light-limited because of the extreme turbidity of the river water. At high salinities, production declined despite greater water clarity, apparently due to nitrogen limitation. At the upper bay areal production estimates from moving incubations were significantly lower than estimates from stationary incubations, but no consistent differences were found at the lower bay and in the bay as a whole. This is the first report of moving incubations yielding significantly lower estimates most of the time. The productivity differences between moving incubations and stationary incubations were significantly correlated with relative light penetration. It is suggested that this was because of at least two distinct time-dependent production-versus-irradiance phenomena whose influences varied as conditions changed. (Author's abstract)
W89-00005

CONTRIBUTION OF SPARTINA ALTERNIFLORA TO THE PEDRA DE GUARATIBA (RJ) SALT MARSH SEDIMENT USING CARBON-13 AS A TRACER (CONTRIBUICAO DE MATERIA ORGANICA DE SPARTINA ALTERNIFLORA PARA O SEDIMENTO DO ALAGADO DE PEDRA DE GUARATIBA (RJ): USO DE C13 COMO TRACADOR),
Universidade Federal do Rio de Janeiro (Brazil). Inst. de Biofisica.
N. R. W. lima, L. A. Martinelli, R. L. Victoria, and A. A. Mozeto.
Revista Brasileira de Biologia RBBIAL, Vol. 47, No. 4, p 487-491, November 1987. 2 fig, 2 tab, 22 ref. English summary.

Descriptors: *Brazil, *Salt marshes, *Sediments, *Decomposing organic matter, *Decomposition, *Spartina, Plant tissues, Organic compounds, Carbon radioisotopes, Isotope tracers, Water depth, Isotope studies, Pedra de Guaratiba.

The carbon-13 isotopic composition (delta-carbon-13) of Spartina alterniflora and of the sediment at three different depths were determined in the Pedra de Guaratiba salt marsh (Rio de Janeiro). Values obtained for S. alterniflora ranged between -13.0 and -14.3 per thousand. Leaves, stems, rhizome dead leaves and decomposing tissues were analyzed; values obtained for the sediment were -19.3 (0-2 cm), -19.5 (2-17 cm) and -24.4 per thousand (17-32 cm), clearly indicating the contribution of S. alterniflora to the organic matter in the surface layers. Isotope dilution calculations showed that about 50% of the organic matter in the first 17 cm of the sediment is derived from S. alterniflora. (Author's abstract)
W89-00010

PIPE FLOW IN JAMES BAY COASTAL WETLANDS,
McMaster Univ., Hamilton (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 2A.
W89-00047

CORRELATIONS BETWEEN SALINITY AND GROWTH OF THE SEAGRASS AMPHIBOLIS ANTARCTICA (LABILL.) SONDER & ASCHERS., IN SHARK BAY, WESTERN AUSTRALIA, USING A NEW METHOD FOR MEASURING PRODUCTION RATE,
Western Australia Univ., Nedlands. Dept. of Botany.
D. I. Walker.
Aquatic Botany AQBODS, Vol. 23, No. 1, p 13-26, October 1985. 12 fig, 1 tab, 16 ref.

Descriptors: *Bays, *Data acquisition, *Aquatic productivity, *Salinity, *Plant growth, *Sea grasses, Coastal waters, Amphibolis, In situ tests, Tagging, Leaves, Biomass, Hypersaline waters, Shark Bay, Western Australia.

A method of estimating above-ground productivity in situ of the seagrass Amphibolis antarctica devised, using tags to determine rates of leaf turnover. This has proved an effective tool in establishing the behavior of the species in relation to the gradient of increasing salinity which is present in Shark Bay. No seagrass was found beyond 64 parts per thousand, but measurement of production and biomass within dense patches of seagrass at different salinities revealed that these were at a maximum at a salinity of 42 parts per thousand, decreasing as the salinity increased and also at lower oceanic concentrations. Production rates ranged from 2 to 17 g dry weight/sq m/day with biomass from 600 to 2000 g/sq m, thus A. antarctica is one of the more productive Australian seagrass species, even in the hypersaline conditions of Shark Bay. Despite the obvious correlation between above-ground production and salinity, it is pointed out that the results are not taken to imply causality. (Author's abstract)
W89-00102

SEASONAL ABUNDANCE AND DISTRIBUTION OF DRIFT ALGAE AND SEAGRASSES IN THE MID-INDIAN RIVER LAGOON, FLORIDA,
R. W. Virnstein, and P. A. Carbonara.
Aquatic Botany AQBODS, Vol. 23, No. 1, p 67-82, October 1985. 7 fig, 46 ref.

Descriptors: *Estuaries, *Algae, *Sea grasses, *Seasonal distribution, *Population density, *Lagoons, Benthic flora, Distribution patterns, Mapping, Biomass, Light intensity, Animal populations, Nutrients, Primary productivity, Halodule, Syringodium, Thalassia, Gracilaria, Indian River, Florida.

Seagrasses in a 15-ha area on Florida's central east coast were mapped. Halodule wrightii dominated in shallow (< 0.4 m) and Syringodium filiforme in deeper water (> 0.5 m). Thalassia testudinum occurred as scattered patches. Areal coverage of monospecific stands of the three major seagrasses was: Syringodium 35%, Halodule 14%, Thalassia 6%, and bare sand 21%. Mixed species stands, mostly Syringodium with Halodule, covered 25% of the total study area. Above-ground seagrass biomass was maximum in early summer (June-July) and minimum in late winter (February-March). Summer maxima ranged from 60 g dry wt./sq m for Syringodium to about 300 g dry wt./sq m for Thalassia, with Halodule intermediate at 160 g dry wt. per sq m. Because distribution of unattached benthic macroalgae ('drift algae'), primarily Gracilaria spp., was highly aggregated, aggregations were first mapped, followed by stratified quadrat sampling in order to estimate total drift algal abundance. In April 1982, high-density patches covering a few hectares averaged 409 g dry wt./sq m. Other large expanses of the lagoon had similar accumulations of drift algae; densities of some accumulations exceeded 15,000 g dry wt./sq m. Year-to-year variability of seagrass and drift algal abundance was high and may be related to variations in light levels. Drift algae harbor high densities of animals and at times may be quantitatively more important locally than seagrasses in terms of habitat, nutrient dynamics and primary production. (Author's abstract)
W89-00104

NITROGEN POOLS AND SOIL CHARACTERISTICS OF A TEMPERATE ESTUARINE WETLAND IN EASTERN AUSTRALIA,
New South Wales Inst. of Tech., Broadway (Australia). School of Life Sciences.
For primary bibliographic entry see Field 5B.
W89-00110

EFFECT OF SEDIMENT DEPTH AND SEDIMENT TYPE ON THE SURVIVAL OF VALLISNERIA AMERICANA MICHX GROWN FROM TUBERS,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2H.
W89-00114

EFFECTS OF SEDIMENT PROPERTIES ON BENTHIC PRIMARY PRODUCTION IN THE COLUMBIA RIVER ESTUARY,
Oregon State Univ., Corvallis. Dept. of Botany and Plant Pathology.
C. D. McIntire, and M. C. Amspoker.
Aquatic Botany AQBODS, Vol. 24, No. 3, p 249-267, June 1986. 7 fig, 5 tab, 38 ref.

Descriptors: *Estuaries, *Sediments, *Benthic flora, *Primary productivity, *Aquatic productivity, *Intertidal areas, Tidal flats, Diatoms, Phytoplankton, Marsh plants, Regional analysis, Distribution patterns, Columbia River.

Sediment effects on production were investigated along intertidal transects. On the tidal flats, benthic diatoms were the most abundant plants, while macroalgae and submergent vascular macrophytes were relatively rare. At five intensive study sites, mean rates of benthic primary production varied between 5 mg C/sq m/h at Clatsop Spit and 84 mg C/sq m/h at Youngs Bay. A regional analysis of data from these sites and from 31 less intensively studied survey sites indicated that Youngs Bay and Baker Bay were more productive than Grays Bay, Cathlamet Bay and the tidal flats in the upper estuary above these bays. This pattern corresponded to the stability and particle-size distribution of the sediment in these areas. Benthic gross primary production for the total estuarine area of 410 sq km was estimated to be 4895 t C/yr and represents a mean rate of 72 g C/sq m/yr. Of this total net primary production in the estuary, benthic plants accounted for about 7%, while phytoplankton and emergent vascular plants in the marshlands contributed approximately 56% and 37%, respectively. Data from this study also suggested that physical processes related to estuarine circulation can ultimately determine the productivity of benthic plant assemblages, and minimize the regulatory and limiting effects of temperature, nutrient supply and consumption by benthic animals. (Author's abstract)
W89-00115

LOSS OF SEAGRASS IN COCKBURN SOUND, WESTERN AUSTRALIA: II. POSSIBLE CAUSES OF SEAGRASS DECLINE,
Western Australia Univ., Nedlands. Dept. of Botany.
For primary bibliographic entry see Field 5C.
W89-00116

ROLE OF MARSH PLANTS IN THE TRANSPORT OF NUTRIENTS AS SHOWN BY A QUANTITATIVE MODEL FOR THE FRESHWATER SECTION OF THE ELBE ESTUARY,
Hamburg Univ. (Germany, F.R.). Inst. fuer Hydrobiologie und Fischereiwissenschaft.
C. W. Heckman.
Aquatic Botany AQBODS, Vol. 25, No. 2, p 139-151, September 1986. 3 fig, 2 tab, 21 ref.

Descriptors: *Estuaries, *Wetlands, *Marsh plants, *Nutrients, *Dikes, Mathematical models, Storm tides, Detritus, Elbe River, Germany, Leaching, Phosphorus.

The movement of nitrogen and phosphorus compounds in the freshwater section of the Elbe estuary and its adjacent wetlands was investigated. Quantitative estimates indicate that littoral macrophytes, especially Phragmites australis, Schoenoplectus lacustris, and S. tabernaemontani, are responsible for mediating the removal of large quantities of these nutrients from the aquatic system, where they are undesirable, to inland parts of the flood plain, where they provide valuable fertilizer for terrestrial plants, including cultivated crops. The transport occurs when the tides, particularly the winter storm tides, carry the dead emergent plant material inland. Analyses showed that this detritus contains quantities of N and P comparable to those in the living plant tissues. Recent dike construction has reduced the area of tidal marshland bordering the Elbe and inhibits the self-clensing of the estuarine water and tidal flat sediments. The blockage of the winter storm tides has resulted in the appearance of huge piles of dead plants at the bse of the dike. Before dike construction almost all of this natural fertilizer remained for inland but now it is likely to be leached back into the estuary. (Shidler-PTT)
W89-00120

MODEL OF ZOSTERA MARINA L. PHOTOSYNTHESIS AND GROWTH: SIMULATED EFFECTS OF SELECTED PHYSICAL-CHEMICAL VARIABLES AND BIOLOGICAL INTERACTIONS,
Virginia Inst. of Marine Science, Gloucester Point.
R. L. Wetzel, and H. A. Neckles.
Aquatic Botany AQBODS, Vol. 26, No. 3/4, p 307-323, December 1986. 4 fig, 2 tab, 40 ref.

Descriptors: *Marine plants, *Model studies, *Sea grasses, *Eelgrass, *Photosynthesis, *Plant growth, *Simulation analysis, Physicochemical properties, Biological properties, Nonlinear programming, Solar radiation, Temperature, Epiphytes, Chesapeake Bay, Virginia.

A computer model was developed to simulate photosynthesis and growth of eelgrass (Zostera marina), the dominant submerged aquatic macrophyte occurring in the lower Chesapeake Bay. The mathematical structure of the model is based on theoretical non-linear functions for simulating biologically-controlled processes and empirical or statistical relationships for incorporating physical-chemical interactions and environmental forcing functions. Analyses of the model for 1-, 4-, and 10-year simulation periods indicate that submarine light quantity and temperature are the principal physical factors governing eelgrass photosynthesis and growth in the lower bay. Typical in-situ light and temperature conditions, however, constrain photosynthesis and therefore plant growth to less than physiologically-capable potentials. Small changes in submarine irradiance, temperature, or their combined interaction result in decreased plant productivity and eventual loss of the eelgrass com-

munity. Empirical and hypothetical relationships in the model of epiphyte colonization and growth and epiphytic grazing indicate that eelgrass growth and long-term survival are potentially governed by factors that control and limit the attached epiphytic community. Model simulations suggest that a principal factor is the interaction between epiphytic grazing intensity and ambient light levels. (Author's abstract)
W89-00130

OUTWELLING FROM TROPICAL TIDAL SALT FLATS,
Australian Inst. of Marine Sciences, Townsville.
P. Ridd, M. W. Sandstrom, and E. Wolanski.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 26, No. 3, p 243-253, March 1988. 4 fig, 1 tab, 14 ref.

Descriptors: *Tidal flats, *Salinity, Salt balance, *Salt flats, *Suspended sediments, *Nutrients, *Australia, *Cycling nutrients, Norman River Estuary, Prawns, Gulf of Carpentaria, Trapping, Flushing, Estuarine environment, Crustaceous, Tropical regions, Outwelling, Estuaries.

The outwelling of salt and nutrients from the tropical tidal salt flats to the Norman River estuary in the southern region of the Gulf of Carpentaria in Australia was measured. This estuary is a vital habitat for juvenile banana prawns. The study was timed to coincide with the spring tides of mid-November 1985 and the first tidal inundation of the salt flats in the summer. Occasional tidal inundation of the salt flats during summer results in stronger tidal currents and higher turbidity and suspended-sediment concentrations in the estuary. It also results in an outwelling of salt and nutrients to both the estuary and the nearshore waters of the Gulf. Values of 90 g salt/sq m, 1.0 mmole silicate, and 0.03 mmole orthophosphate/sq m per tidal cycel are removed by outwelling. The ecological effects of this outwelling are unknown, but may be important to the survival of juvenile prawns in the Gulf of Carpentaria. (Miller-PTT)
W89-00140

FAUNAS OF LAND-LOCKED LAGOONS: CHANCE DIFFERENCES AND THE PROBLEMS OF DISPERSAL,
Cambridge Univ. (England). Dept. of Zoology.
R. S. K. Barnes.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 26, No. 3, p 309-318, March 1988. 4 fig, 2 tab, 34 ref. Nature Conservancy Council contract HF/3/11/37.

Descriptors: *Fauna, *Lagoons, *Species diversity, *Brackish water, *Salinity, *Coastal water, East Anglia, England, Colonization, Coastal lagoons, Water birds, Barriers, Coastal geomorphology, Estuarine hydrology.

The species richness and faunal similarities of a series of 24 land-locked, brackish coastal lagoons in East Anglia, England, were analyzed for potential causal factors. Variation in species richness cannot be explained by such parameters as hydrological regime, substratum, age or area. Only salinity and isolation have significant effects although they account for less than 20% of the total variation. The two faunal-similarity tests used gave different results, but the relatively few statistically significant faunal similarities displayed on either basis are not related to habitat similarity in terms of hydrography, sediment type, area, or usage by coastal birds. Only salinity consistently exerted a significant effect, although geographical proximity and age were significant on one of the two tests. Apart from the effect of salinity, it is concluded that the depauperate lagoonal faunas are largely chance assemblages resulting from the vagaries of colonization patterns. Dispersal from lagoon to lagoon probably was effected mainly during periods of coastal seawater flooding but, if this is so, the supply of colonists has now been cut off by recent coastal defense works. (Author's abstract)
W89-00141

RESIDUAL FLUXES OF WATER IN AN ESTUARINE LAGOON,
Basrah Univ. (Iraq). Marine Science Centre.
B. M. Al-Ramadhan.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 26, No. 3, p 319-330, March 1988. 7 fig, 1 tab, 12 ref.

Descriptors: *Estuaries, *Lagoons, *Iraq, *Khowr Al-Zubair, *Tidal basins, *Tides, Hydrologic budget, *Water circulation, *Water currents, Arabian Gulf, Iraq, Seasonal variation, Tidal cycles.

Observations of currents are presented for three stations in Khowr Al-Zubair (south Iraq). The observations were made over a complete tidal cycle, on both neap and spring tides, and the data analyzed to provide estimates of the residual fluxes of water. Relative to the depth-averaged values, the axial residual currents showed a seaward flow in the upper layer, and landward flow in the bottom layer, for all stations in the wet season. The situation was reversed (landward flow in the upper layer and seaward flow in the lower layer in the dry season (no freshwater discharge). (Author's abstract)
W89-00142

HEAT BALANCE OF A TIDAL FLAT AREA,
Vrije Univ., Amsterdam (Netherlands). Dept. of Meteorology.
H. F. Vugts, and J. T. F. Zimmerman.
Netherlands Journal of Sea Research NJSRBA, Vol. 19, No. 1, p 1-14, August 1985. 10 fig, 1 tab, 14 ref.

Descriptors: *Tidal flats, *Heat balance, *Model studies, *Water temperature, Net radiation, Prediction, Wadden Sea, Diffusivity, Thermal properties, The Netherlands, Tides, Physical properties, Daily mean water temperature.

The results of a heat balance investigation of tidal flats in the western part of the Dutch Wadden Sea are presented. It is shown that the heat balance studies of tidal flat areas, which are very complicated due to the tidal cycle, can be carried out with success. Apparently, bottom properties can be derived from the temperature measurements at different depths. Thermal diffusivity (alpha) was established at 0.00000106 sq m per sec. The albedo of the tidal flat was 0.14, whereas for water a value of 0.06 can be used. For mean daily heat balance calculations, an average albedo value of 0.10 should be used. The net radiation can be estimated with reasonable accuracy from simple weather data from nearby coastal stations. Then it is shown that the daily heat balance interacts with the tidal cycle resulting in a 15-day periodicity in the water temperature as well as the bottom temperature. Further, it is demonstrated that with a simple model and some measured 'bulk' parameters, it is possible to predict daily mean water temperatures during the whole measuring period from simple weather data measured at a nearby coastal station. (Author's abstract)
W89-00148

RIVER EMS: PROCESSES AFFECTING THE BEHAVIOUR OF METALS AND ORGANOCHLORINES DURING ESTUARINE MIXING,
Nederlands Inst. voor Onderzoek der Zee, Texel.
For primary bibliographic entry see Field 5B.
W89-00149

MONITORING OF MERCURY POLLUTION IN DUTCH COASTAL WATERS BY MEANS OF THE TELEOSTEAN FISH ZOARCES VIVIPARUS,
Rijkswaterstaat, The Hague (Netherlands). Div. of Tidal Waters.
For primary bibliographic entry see Field 5C.
W89-00150

DREDGING ACTIVITIES IN THE DUTCH WADDEN SEA: EFFECTS ON MACROBENTHIC INFAUNA,
Nederlands Inst. voor Onderzoek der Zee, Texel.
H. W. Van Der Veer, M. J. N. Bergman, and J. J. Beukema.
Netherlands Journal of Sea Research NJSRBA, Vol. 19, No. 2, p 183-190, November 1985. 2 fig, 3 tab, 29 ref.

Descriptors: *Wadden Sea, *Dredging, *Benthos, *Tidal flats, *Environmental effects, *Estuarine environment, *Sand, Sediments, Macroinvertebrates, Water currents, Colonization.

Effects of dredging on macrobenthic infauna were studied at several sites and water depths in the estuarine Dutch Wadden Sea. Dredging in tidal flats areas was found to have long-lasting effects: (1) filling-in rates in such areas were extremely slow, (2) sediment composition was altered dramatically, and (3) recovery of benthos was virtually absent during the long period of filling-in. Such pits on tidal flats persisted for more than 15 years. In subtidal areas, recovery of bottom structure as well as the inhabiting infaunal benthos proceeded rapidly although the original situation may be expected to return. In tidal channels with strong currents, both filling-in and recolonization took only about 1 to 3 years. In some subtidal areas with low tidal stream velocities, such as tidal watersheds, recovery took from 5 to 10 years. (Author's abstract)
W89-00151

NUTRIENT DYNAMICS IN CUMBERLAND BASIN - CHIGNECTO BAY, A TURBID MACROTIDAL ESTUARY IN THE BAY OF FUNDY, CANADA,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Marine Ecology Lab.
P. D. Keizer, and D. C. Gordon.
Netherlands Journal of Sea Research NJSRBA, Vol. 19, No. 3/4, p 193-205, December 1985. 8 fig, 7 tab, 41 ref.

Descriptors: *Bay of Fundy, *Cumberland Basin, *Chignecto Bay, *Estuaries, *Bays, *Cycling nutrients, *Suspended sediments, Tides, Nutrients, Basins, Canada.

An extensive ecological study of the Bay of Fundy has been conducted over the last five years. The concentrations of nutrients was measured in numerous compartments of this ecosystem on different scales of time and space. While nutrient concentrations in the water column never approached limiting values, concentrations were a complex function of numerous physical and environmental factors. The effects of high concentrations of suspended sediments and the high energy input from the large tidal range on the dynamics of nutrients in this estuary are discussed in detail in an attempt to evaluate sources and sinks of nutrients in the estuary. Due to the lack of information on residual water fluxes, estimations of the magnitude and direction of nutrient fluxes in the estuary are only qualitative. (Author's abstract)
W89-00152

EVALUATION OF SEASONAL NUTRIENT DYNAMICS IN THE OOSTERSCHELDE (SW NETHERLANDS),
Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
L. A. Van Geldermalsen.
Netherlands Journal of Sea Research NJSRBA, Vol. 19, No. 3/4, p 207-216, December 1985. 7 fig, 1 tab, 27 ref.

Descriptors: *Oosterschelde estuary, *The Netherlands, *Estuarine environment, *Cycling nutrients, *Seasonal variation, *Nitrogen compounds, *Organic matter, Silica, hosphorus, North Sea, Estuaries, Nutrients, Sediment.

A large set of data obtained from several monitoring programs covering more than 3 years in the Oosterschelde Estuary (The Netherlands) were used to evaluate seasonal trends in dissolved nutritive compounds. The deviations from conservative behavior were calculated. It is concluded that specific estuarine processes control the distributions of nitrogen compounds within the estuary and that these processes are depend largely on the input of organic material from the sea. Levels of silica are almost completely governed by fresh water dis-

charges throughout the year, except for the Keeten-Krammer area in spring. Phosphorus concentrations are steady throughout the year with minor influences of exchange with sediment in spring and summer and an influence of the North Sea in spring. (Author's abstract)
W89-00153

NITRITE AND AMMONIA IN THE TAMAR ESTUARY,
Institute for Marine Environmental Research, Plymouth (England).
For primary bibliographic entry see Field 5B.
W89-00154

NITROGEN BUDGET OF THE SCHELDT HYDROGRAPHICAL BASIN,
Universite Libre de Bruxelles (Belgium). Lab. d'Oceanographie.
For primary bibliographic entry see Field 5B.
W89-00155

COMPARISON OF NUTRIENTS IN THE INTERSTITIAL WATER OF REDUCING (TAMAR ESTUARY) AND OXIC (CARMARTHEN BAY) COASTAL SEDIMENTS,
Institute for Marine Environmental Research, Plymouth (England).
P. G. Watson, P. E. Frickers, and C. M. Goodchild.
Netherlands Journal of Sea Research NJSRBA, Vol. 19, No. 3/4, p 231-239, December 1985. 5 fig, 32 ref.

Descriptors: *Estuaries, *Bays, *England, *Tamar Estuary, *Carmarthen Bay, *Interstitial water, *Seasonal variation, Silicate, Nitrates, Nitrites, *Ammonia, Orthophosphate, Spatial distribution, Temporal distribution, Ferrous iron, England, Bristol Channel, Sediments, Oxidation-reduction potential.

Temporal and spatial variations in the interstitial water concentration gradients of ammonia, orthophosphate, nitrate, nitrite, silicate and ferrous iron were determined in the anoxic silts of the Tamar Estuary, SW England and in the more oxic, sandy sediments of Carmarthen Bay in the Bristol Channel. A comparison of these results, together with determinations of sediment redox potential and particulate carbon and nitrogen, is made to describe a broader perspective than can be identified in either zone individually. The overall comparison shows: (1) a closer correlation between interstitial water components and dissolved organic carbon, (2) seasonal variability in interstitial water silicate and phosphate indicative of different source materials and of competing processes of production and control, and (3) the variable influence on interstitial water profiles of regular and periodic sediment disturbance. (Author's abstract)
W89-00156

MODELLING RESEARCH ON THE PRODUCTION CYCLE OF PHYTOPLANKTON IN THE SOUTHERN BIGHT OF THE NORTH SEA IN RELATION TO RIVERBORNE NUTRIENT LOADS,
Nederlands Inst. voor Onderzoek der Zee, Texel.
H. G. Fransz, and J. H. G. Verhagen.
Netherlands Journal of Sea Research NJSRBA, Vol. 19, No. 3/4, p 241-250, December 1985. 8 fig, 4 tab, 43 ref.

Descriptors: *Phytoplankton, *North Sea, *Primary productivity, *Eutrophication, *Water pollution effects, *Coastal waters, *Seawater, *Nutrients, Nitrogen, Phosphorous, Biomass, Water pollution, Silica, Diatoma, Flagellates, Mathematical models, Nitrogen cycle.

A mathematical model was used to simulate the seasonal variation in diatom and other phytoplankton carbon, and the nutrients P, N and Si, in 7 area compartments at different distances from the Dutch coast for nutrient load conditions of 1980 and 1930. For this area and period the main results suggest that: (1) within 30 km from the coast, the biomass of flagellates increased by a factor of 2 to 4, causing an important shift in species composition; (2) the nutrient load of water crossing the southern border and the river discharge are of equal importance for the water quality; (3) within 16 km from the coast, the algal biomass is limited by dispersal exchange with more offshore waters rather than by nutrient depletion; (4) beyond 16 km from the coast, diatoms are limited during summer by Si; other phytoplankton by P depletion; and (5) the primary production doubled at most, increasing the production of the southern North Sea by 17%. (Miller-PTT)
W89-00157

SEASONAL VARIATIONS AND SPATIAL GRADIENTS OF NITROGENOUS NUTRIENTS IN WATERS OF SOUTHEASTERN VANCOUVER ISLAND, BRITISH COLUMBIA, CANADA.
Victoria Univ. (British Columbia). Dept. of Biology.
L. A. Hobson.
Netherlands Journal of Sea Research NJSRBA, Vol. 19, No. 3/4, p 251-256, December 1985. 3 fig, 17 ref.

Descriptors: *Seasonal variation, *Nutrients, *Nitrogen compounds, *Saanich Inlet, Canada, Inorganic compounds, Phytoplankton, Fjords, Advection, Spatial distribution, British Columbia, Vancouver Island, Diffusion, Phytoplankton, Primary productivity, Model studies, Hydrologic models, Tides, Waves, Wind.

The study was conducted to begin testing the hypothesis that supplies of inorganic nitrogen are adequate to support rates of phytoplankton production observed in Saanich Inlet, a fjord in Vancouver Island, British Columbia, Canada. To test this hypothesis, rates of nitrogen transport into and within the euphotic zone by advection and diffusion are needed. Computation of these rates requires knowledge of spatial gradients, which were determined from spatial distributions of NO3-N, NO2-N, and NH4-N measured during the spring, summer and fall months of 1977, 1983, and 1984 in water of the southeastern coast of Vancouver Island. Of the nitrogenous nutrients, vertical gradients of NO3-N were largest, usually exceeding 0.75 microM per m in the upper 10 m of the water column during late spring and summer months. During these same months, horizontal gradients were small, varying between 1.5 and 2.0 microM per km. A model was used to estimate the relative importance of horizontal and vertical diffusion to nutrient supply in the euphotic zone and results indicated that vertical diffusion would dominate. Thus, it is likely that vertical advection and diffusion driven by winds, internal waves and tidal currents were important sources of nutrients to phytoplankton in Saanich Inlet during late spring and summer months. (Author's abstract)
W89-00158

ROLE OF SEWAGE EFFLUENT IN THE ACCUMULATION OF MACROALGAL MATS ON INTERTIDAL MUDFLATS IN TWO BASINS IN SOUTHERN ENGLAND,
Southern Water Authority, Otterbourne (England).
For primary bibliographic entry see Field 5C.
W89-00159

USE OF PLANT MICRO-NUTRIENT AND CHLOROPHYLL RECORDS AS INDICES OF EUTROPHICATION IN INSHORE WATERS,
University Coll. of North Wales, Menai Bridge. Marine Science Labs.
For primary bibliographic entry see Field 5A.
W89-00160

EXAMINATION OF THE CONNECTION BETWEEN THE PATCHINESS OF BENTHIC NUTRIENT EFFLUX AND EPIPHYTOBENTHOS PATCHINESS ON INTERTIDAL FLATS,
Oldenburg Univ. (Germany, F.R.). Fachbereich 7 - Biologie.
T. Hopner, and K. Wonneberger.
Netherlands Journal of Sea Research NJSRBA, Vol. 19, No. 3/4, p 277-285, December 1985. 10 fig, 27 ref.

Descriptors: *Benthos, *Nutrients, *Tidal flats, *Diatoms, *Spatial distributions, Ammonia, Phosphate, Nitrogen, Sediment-water interfaces, Patchiness, Algal growth.

Intertidal epiphytobenthos activity (expressed in mmole oxygen evolution per sq m h) and nutrient efflux out of the sediment (computed from pore water nutrient concentration profiles and expressed in micromole per sq m h) were studied at the same places. Increased ammonia or phosphate efflux stimulated epiphytobenthos activity, and an optimum of epiphytobenthos activity was observed when the molar N:P ratio in the efflux agreed with the N:P ratio in diatom biomass. It is concluded that epiphytobenthos patchiness depends on the spatial distribution of nutrient efflux and on the N:P ratio in the efflux. The conditions of nutrient efflux were further studied by fertilizing the sediment with urea and phosphate. Phosphate could be traced in the pore water over two months; ammonia over more than two months. The formation of a diatom bed at the fertilized area was observed once, but efforts to reproduce it failed indicating the importance of other growth-determining conditions. Nutrient efflux was prevented by a plastic foil to simulate a possible efflux inhibition by diatom mats. Concentrations below the foil were examined and compared with results from an untreated area. An increase of nutrient concentrations in the pore water was observed. (Author's abstract)
W89-00161

PRELIMINARY STUDY ON THE MIGRATION AND TRANSFORMATION OF HEAVY METALS IN THE SEWAGE-SEAWATER MIXING ZONE OF JINZHOU BAY, (IN CHINESE),
Institute of Marine Environmental Protection, Dalian (China).
For primary bibliographic entry see Field 5B.
W89-00199

CHEMICAL BEHAVIOR OF METAL ELEMENTS IN THE SEDIMENTS IN THE HANJIANG RIVER ESTUARY AND SHANTOU PORT, (IN CHINESE),
Academia Sinica, Guangzhou (China). South China Sea Inst. of Oceanology.
L. Zhiqing, Z. Jianlu, and L. Ziqiang.
Oceanologia et Limnologia Sinica, Vol. 19, No. 2, p 201-204, March 1988. 2 fig, 1 tab, 7 ref. English summary.

Descriptors: *China, *Hanjiang Estuary, *Shantou Port, *Trace metals, *Estuaries, *Sediments, Copper, Lead, Iron, Manganese, Aluminum, Silicon, Barium, Beryllium, Chromium, Zinc, Carbonates, Organic compounds, Inorganic compounds, Oxides, Metal complexes.

The chemical forms of 10 elements (Cu, Pb, Fe, Mn, Al, Si, Ba, Be and Cr) in the Hanjiang River Estuary and Shantou Port were studied using the sequential extraction procedure. The chemical forms were: exchangeable, carbonate bound, Fe-Mn oxides bound, the organic and the residual form. Al, Si, Cr, and Ba remained mainly in the residual form in the sediments (about 90%); Cu also remained in the residual form in relatively less percentage (>70%); Fe remained in Fe-Mn oxides and the residual form (>90%). The distributions of Mn, Pb, Be, and Zn were irregular. (Author's abstract)
W89-00202

DISTRIBUTION OF AGGLUTINATED FORAMINIFERA IN BOTTOM SEDIMENTS OF THE ZHUJIANG RIVER ESTUARY, (IN CHINESE),
Beijing Univ. (China).
L. Shuluan.
Oceanologia et Limnologia Sinica, Vol. 19, No. 2, p 187-196, March 1988. 7 fig, 2 tab, 26 ref. English summary.

Descriptors: *Zhujiang Estuary, *China, *Estuaries, *Foraminifera, *Sediments, Species composition, Vertical distribution, Water depth, Salinity, Hydrogen ion concentration, Water temperature, Bottom sediments.

The distribution of 28 species of agglutinated Foraminifera belonging to 14 genera is discussed. According to their depth distribution, two major assemblages are recognized: Ammobaculites formosensis-Haplophragmoides canariensis assemblage occurring in the river estuary (the inner part of the island) with water depth <10 m amd Texularia foliacea-Bigenerina nodosaria assemblage inhabiting the outer part of the island with water depth of 10-30 m. The relationships between the distribution pattern of agglutinated Foraminifera and the environmental factors, e.g. water depth, salinity, temperature, pH, and the bottom sediments are discussed. (Author's abstract)
W89-00203

NUTRIENT LEVELS AND THE DEVELOPMENT OF DIATOM AND BLUE-GREEN BLOOMS IN A SHALLOW AUSTRALIAN ESTUARY,
Western Australia Univ., Nedlands. Dept. of Botany.
For primary bibliographic entry see Field 2H.
W89-00211

EFFECT OF LIGHT REGIME UPON GROWTH RATE AND CHEMICAL COMPOSITION OF A CLONE OF SKELETONEMA COSTATUM FROM THE TRONDHEIMSFJORD, NORWAY,
Trondheim Univ. (Norway). Biological Station.
E. Sakshaug, and K. Andersen.
Journal of Plankton Research JPLRD9, Vol. 8, No. 4, p 619-637, July 1986. 8 fig, 2 tab, 57 ref. Norwegian Research Council for Science and the Humanities Grant D.5573-004.

Descriptors: *Trondheimsfjord, *Norway, *Fjords, *Growth rate, *Skeletonema, *Light intensity, *Photosynthesis, *Cycling nutrients, Tissue analysis, Mathematical studies, Mathematical equations, Organic carbon, Microorganisms, Microbiological studies, Eutrophication, Rivers, Plant physiology, Adaptation, Chlorophyll, Nitrogen, Adenosine triphosphate, Primary productivity.

Nutrient-saturated cultures of Skeletonema costatum were grown at 15 C and 42 combinations of photon flux density (PFD) and daylength. The growth rate increased with the daylength and PFD up to 460-630 microE/sq m/sec (maximum 2.5 doublings/day). At 2000 microE/sq m/sec the growth rate was reduced by 45%. The chlorophyll (chl) content of the cells and the rate of production of carbon per unit chlorophyll and ambient light increased for declining light regimes as did cellular nitrogen and carbon. The N/C ratio, cellular phosphorus and ratios between in vivo fluorescence, with and without 3-(3,4-dichlorophenyl)-1,1-dimethylurea, and chlorophyll varied negligibly. The ATP/C ration was linearly related to the growth rate. The results were described mathematically. The chl/C ratio was low both in strong light and in marginally low light, corresponding to low cellular chlorophyll and high cellular carbon, respectively. The observed increase in cellular nitrogen and carbon at shade adaptation probably represent an increase in the size of internal stores of organic nitrogen and may imply that Skeletonema cells become enriched with organic nitrogen when staying in nitrate-rich subsurface layers, e.g. in or below a nutricline. However, close to zero growth in marginal light the cells become greatly enriched with respect to every measured factor. Such cells may be physiologically resting stages which may ensure survival during dark periods promote rapid development during the initial phase of blooms. Cultures and natural blooms of Skeletonema in the Trondheimsfjord exhibit very similar patterns of variation. (Author's abstract)
W89-00212

NITROGEN DYNAMICS IN LOWER NARRAGANSETT BAY: II. PHYTOPLANKTON UPTAKE, DEPLETION RATES OF NITROGENOUS NUTRIENT POOLS, AND ESTIMATES OF ECOSYSTEM REMINERALIZATION,
Rhode Island Univ., Kingston. Graduate School of Oceanography.
M. J. Furnas, T. J. Smayda, and E. A. Deason.
Journal of Plankton Research JPLRD9, Vol. 8, No. 4, p 755-769, July 1986. 6 fig, 3 tab, 54 ref. NSF Grant OCE 76-22653.

Descriptors: *Nitrogen, *Narragansett Bay, *Coastal waters, *Phytoplankton, *Rhode Island, *Population dynamics, *Cycling nutrients, *Bioaccumulation, *Mineralization, Field tests, Limiting nutrients, Bays, Zooplankton, Aquatic habitats, Aquatic animals.

Phytoplankton nitrogen demand in lower Narragansett Bay, Rhode Island, measured during the winter-spring of 1977-78 and summers of 1978 and 1979, is compared with estimates of zooplankton and the benthic nitrogen remineralization drawn from the results of experimental field studies. Measured uptake rates would generally lead to the depletion of available nitrogenous nutrient stocks within hours, and usually exceeded estimates of benthic plus zooplankton remineralization. Additional estimates of nitrogen inputs from sewage and riverine sources appear insufficient to make up the difference. The discrepancy lends support to the paradigm that water column remineralization by microheterotrophs may supply much, if not most, of the nitrogen needs of coastal phytoplankton. (Author's abstract)
W89-00215

TIDAL TRANSPORT OF PLANKTONIC COPEPODS ACROSS THE SILL OF A BRITISH COLUMBIA FJORD,
British Columbia Univ., Vancouver. Dept. of Oceanography.
A. G. Lewis, and A. C. Thomas.
Journal of Plankton Research JPLRD9, Vol. 8, No. 6, p 1079-1089, November 1986. 1 fig, 2 tab, 24 ref.

Descriptors: *Estuaries, *Tidal effects, *Copepods, *Fjords, *Zooplankton, *Water currents, Species composition, Seasonal variation, Aquatic habitats, Aquatic animals, Microorganisms, Transport, Indian Arm Fjord, British Columbia, Sills, Animal behavior, Vertical distribution.

Estimates of plankton transport into and out of semi-enclosed bodies of water could be of value in long-term ecological monitoring. The study reported here examined the problems associated with the estimates of tidal transport of four species of planktonic copepods across the sill of a Indian Arm Fjord, British Columbia. Transport was estimated by applying calculated tidal volume exchange to plankton field data collected over a 13-month period. Hydrographic data during the period indicated that tidal exchange was the dominant mechanism for the transport of water. Differences in depth distribution and behavior resulted in a species-specific effect of tidal exchange. The diel vertical migration of Metridia lucens and the ontogenetic migration of Eucalanus bungi resulted in transport only during those periods when organisms were present in water near or above sill depth. Corycaeus anglicus was present above sill depth at all times and transport occurred throughout the study period. Euchaeta japonica, although present in water above sill depth throughout the year, was transported across the sill only during the winter months. Transport estimates could be related to estimates of fjord concentrations for C. anglicus and E. bungii. For M. lucens and E. japonica, it is suggested that natality and mortality within the inlet was sufficient to mask the effect of tidal transport on the species concentration. (Author's abstract)
W89-00221

ROTIFERS OF WARRI RIVER, NIGERIA,
Benin Univ., Benin City (Nigeria). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W89-00222

TINTINNIDS AND OTHER MICROZOOPLANKTON - SEASONAL DISTRIBUTIONS AND RELATIONSHIPS TO RESOURCES AND HYDROGRAPHY IN A MAINE ESTUARY,
Maine Univ., Orono. Dept. of Zoology.
R. W. Sanders.
Journal of Plankton Research JPLRD9, Vol. 9, No. 1, p 65-77, January 1987. 3 fig, 4 tab, 43 ref. NSF Grant ISP-8011448.

Descriptors: *Tintinnids, *Estuaries, *Population dynamics, *Zooplankton, *Seasonal distribution, Temporal distribution, Biomass, Microorganisms, Rivers, Species composition, Damariscotta River Estuary, Maine, Chlorophyll, Pigments, Ciliates.

Species composition and abundance of tintinnids and other microzooplankton were studied in the Damariscotta River estuary, Maine, USA during the period March 1981 to May 1982. Peak tintinnid abundances occurred during spring and summer and exceeded 7,000/L. Spearman rank correlation coefficients indicated that temperature, nanoplankton chlorophyll and pheopigments passing a 20 micron filter were important factors correlating with total tintinnid density. Species composition of tintinnids changed seasonally and was similar in the spring of both years. Non-loricate ciliates were also most abundant in the spring, reaching peak densities of 45,000/L in April 1982. Rotifers were most common up estuary in the spring. (Author's abstract)
W89-00223

CLOUDS, DEEP CHLOROPHYLL MAXIMA AND THE NUTRIENT SUPPLY TO THE MIXED LAYER OF STRATIFIED WATER BODIES,
Washington Univ., Seattle. School of Oceanography.
K. Banse.
Journal of Plankton Research JPLRD9, Vol. 9, No. 5, p 1031-1036, September 1987. 1 tab, 23 ref. NASA Grant NAWG-1007.

Descriptors: *Clouds cover, *Chlorophyll, *Limiting nutrients, *Cycling nutrients, *Density stratification, *Photosynthesis, *Seasonal variation, *Primary productivity, Aquatic habitats, Aquatic plants, Shading, Light intensity, Pyconocline, Solute transport, Diffusion.

A deep chlorophyll maximum (DCM) is common in the pyconocline of the offshore tropical and subtropical oceans outside of divergences as well as in temperate seas and lakes during summer. It traps the diffusive flux of nutrients into the depleted upper layers. When the DCM and the associated nutricline are situated in the top of the pycnocline, cloudiness materially reducing photosynthesis in the DCM may lead to a nutrient flux into the mixed layer. For the warm seas, with the DCM and the nutricline being usually deep in the stratified domain, it is shown here that even severe cloud cover can only be expected to lead to enhanced nutrient flux into the upper parts of the pycnocline but not the mixed layer. The same is likely for temperate seas and deep lakes during the height of the summer. The implication of irregular, enhanced upward flux of nitrate for the ratio of new/regenerated primary production is noted. (Author's abstract)
W89-00227

CONTEMPORARY CHANGES IN COASTAL BIOCENOSES OF THE GDANSK BAY (SOUTH BALTIC), A REVIEW,
Morski Inst. Rybacki, Gdynia (Poland).
M. Plinski, and K. Wiktor.
Polskie Archiwum Hydrobiologii PAHYA2, Vol. 34, No. 1, p 81-90, 1987. 7 fig, 25 ref.

Descriptors: *Gdansk Bay, *Eutrophication, *Water pollution effects, *Poland, *Baltic Sea, *Aquatic habitats, Aquatic animals, Microorganisms, Coastal waters, Species composition, Population dynamics, Biomass, Eutrophication, Regional analysis, Pollution load, Bays, Phytoplankton, Zooplankton, Species diversity, Ecological distribution, Marine animals, Marine plants.

During the past 15-25 years, in the biocenoses of the Gdansk Bay significant changes were found to occur. Alterations of the structure of phyto- and zoobenthos, and changes in their ranges took place. The number of pyrrophyte species decreased, whereas the total density of phytoplankton rose. The numbers of rotifers, particularly of the species typical of greatly eutrophic waters, also augmented. These changes were most intense in the internal part of the Puck Bay. The alterations resulted from an increase in total pollution of coastal waters of the Puck Bay, and from progressing eutrophication. (Author's abstract)
W89-00254

DETERMINATION OF HYDROPHILIC THIOLS IN SEDIMENT POREWATER USING ION-PAIR LIQUID CHROMATOGRAPHY COUPLED TO ELECTROCHEMICAL DETECTION,
National Bureau of Standards (NML), Gaithersburg, MD. Center for Analytical Chemistry.
For primary bibliographic entry see Field 7B.
W89-00266

METEOROLOGICALLY INDUCED FLUSHING IN THREE U.S. EAST COAST ESTUARIES,
National Oceanic and Atmospheric Administration, Stony Brook, NY. Office of Sea Grant.
D. M. Goodrich.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 26, No. 2, p 111-121, February 1988. 5 fig, 2 tab, 19 ref.

Descriptors: *Meteorology, *Estuaries, *Flushing, Tidal currents, Coastal waters, Narragansett Bay, Delaware Bay, Chesapeake Bay, Salinity, Water depth, Seasonal variation.

Meteorologically induced exchange with the coastal ocean is examined for three U.S. east coast estuaries using time series of subtidal volume flux over a common five-month period. A volume of water equal to that of the estuary was discharged every 86.4, 135.3 and 108.8 days for Narragansett, Delaware and Chesapeake Bays, respectively. However, a large fraction of the water discharged to the shelf is recirculated ocean water. For Chesapeake Bay, outflowing estuarine water can be considered as a mixture of 2.4-3.0% water of mean estuarine salinity and the remainder water of oceanic salinity. The degree of meteorological flushing is strongly influenced by mean depth, as a drop in sea level of a given amplitude will force a greater fraction of water from a shallow estuary than from a deep system. The relative importance of the meteorologically forced circulation and the gravitational circulation is frequency dependent, as illustrated by salinity variance at the entrance to Chesapeake Bay. Seasonal salinity variance must ultimately be controlled by seasonal changes in runoff, through the mechanism of gravitational circulation. However, the high coherence of wind-induced changes in bay volume and bay entrance salinity at periods of 2-20 days suggests that meteorologically forced advection is primarily responsible for salinity variance at these time scales. (Author's abstract)
W89-00281

EFFECTS OF DISTURBANCE AND SEVERE SEASONAL FLUCTUATIONS IN ENVIRONMENTAL CONDITIONS ON NORTH TEMPERATE SHALLOW-WATER FISH ASSEMBLAGES,
Oslo Univ. (Norway). Inst. of Marine Biology.
R. D. M. Nash.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 26, No. 2, p 123-135, February 1988. 4 fig, 5 tab, 21 ref.

Descriptors: *Fish, *Shallow water, *Water pollution effects, *Ecological effects, Ecosystems, Dissolved oxygen, Species diversity, Water temperature, Recreation, Norway, Oslofjord, Seasonal variation.

The shallow-water fish populations at one disturbed and one undisturbed site in the Oslofjord, Norway were sampled with a beach seine from September 1981 to September 1982. The inner site (inner fjord; Hvervenbukta) is in the most polluted part of the fjord and has a heavy recreational usage during the summer months, the outer site (Ellingstad) is in a least polluted part of the fjord and has only sporadic recreational usage. Physical conditions at the two sites differ primarily in seasonal changes of dissolved oxygen levels (Hvervenbukta 3.3-11.1 mg/ O2/L and Ellingstad 5.3-7.1 ml O2/ L). Thirty-three fish species were caught at Ellingstad compared with only 23 at Hvervenbukta, with 0.61 similarity in species lists. Both sites had approximately equal numbers of resident and non-resident species. The mean density of individuals was much greater at Hvervenbukta (0.36/sq m) than at Ellingstad (0.04/sq m). Both sites showed a high dominance factor with a few species comprising the majority of the abundance. Overall species diversity, evenness, and species richness were greater at Ellingstad, consistent with the reduced disturbance. The overall range in seasonal similarity was relatively high for both sites as a function of the severe seasonal cycle in temperature (ice cover to approximately 20 C). These relatively high variations are to be expected for north temperate fish assemblages. The range in the seasonal similarity index was greater at Hvervenbukta reflecting increased disturbance. There were dissimilar patterns in the seasonal cycles of community parameters at the two sites. Changes in population structure were largest during the period of recruitment of new year classes. (Author's abstract)
W89-00282

EXCHANGE OF PHOSPHORUS BETWEEN A EUHALINE VEGETATED MARSH AND THE ADJACENT TIDAL CREEK,
South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology and Coastal Research.
For primary bibliographic entry see Field 5B.
W89-00283

DISSOLVED MERCURY BEHAVIOUR IN THE SAINT LAWRENCE ESTUARY,
Centre Champlain des Sciences de la Mer (Quebec).
For primary bibliographic entry see Field 5B.
W89-00285

SPARTINA ALTERNIFLORA DIE-BACK IN LOUISIANA: TIME-COURSE INVESTIGATION OF SOIL WATERLOGGING EFFECTS,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 2H.
W89-00286

WATER COLUMN PRODUCTIVITY ATTRIBUTABLE TO DISPLACED BENTHIC DIATOMS IN WELL-MIXED SHALLOW ESTUARIES,
Mississippi State Univ., Mississippi State. Dept. of Biological Sciences.
G. P. Shaffer, and M. J. Sullivan.
Journal of Phycology JPYLAJ, Vol. 24, No. 2, p 132-140, June 1988. 5 fig, 3 tab, 35 ref. NOAA Sea Grant Program Grant Nos. 04-7-158-44121, NA 80AA-D-00121, NA85AA-D-SG005 and Project Nos. R/CZ33A and 52.

Descriptors: *Estuaries, *Productivity, *Benthic environment, *Diatoms, Mugu Lagoon, Suspended solids, Barataria Estuary, Primary productivity, Wave heights, Tides, Algae, Water columns.

A preliminary study conducted in Mugu Lagoon, California indicated that productivity of ocean water entering the lagoon during flood tides was often several orders of magnitude less than that of the same water mass about 3 h later. Benthic pennate diatoms displaced from the sediments into the water column accounted for the increase. A more detailed study was conducted in Barataria Estuary, Louisiana where, for one month, daily measurements were made of benthic and water column productivity and several other environmental variables. During the month, the relationship between water column and benthic primary productivity varied from strongly negative to weakly negative to positive. K-systems analysis indicated that factors comprised of wave height, meteorological tides, astronomical tides and benthic productivity and standing crop accounted for the full range of variation in water column productivity. Benthic pennate diatoms represented an average of 74% of the diatom taxa in water column samples. It is concluded that the primary productivity of well-mixed shallow estuarine waters is often greatly augmented by displaced benthic algae. (Author's abstract)
W89-00297

POPULATIONS OF ANAEROBIC PHOTOTROPHIC BACTERIA IN A SPARTINA ALTERNIFLORA SALT MARSH,
Clemson Univ., SC. Dept. of Microbiology.
J. R. Paterek, and M. J. B. Paynter.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 6, p 1360-1364, June 1988. 6 tab, 24 ref.

Descriptors: *Salt marshes, *Aquatic bacteria, *Wetlands, Tidal marshes, Anaerobic bacteria, Photosynthetic bacteria, Spartina, Population density, Species composition, Seasonal variation, Aquatic habitats, Artificial habitats, Sapelo Island, Georgia, Culturing techniques, Sediments.

Habitat-simulating media were used with the Hungate anaerobic roll tube technique to enumerate culturable anaerobic photosynthetic bacteria in sediment, tidal water, and Spartina alterniflora plant samples collected form the salt marsh at Sapelo Island, Georgia. No phototrophs were detected in samples of creekside (low marsh) sediment or in tidal waters in creekside regions. In the high marsh region, 90% of anaerobic phototrophic bacteria occurred in the top 5 mm of sediment and none were detected below 6 mm. There was a seasonal variation, with maximal populations occurring in summer and fall (mean, 440,000 phototrophs/g of dry sediment) and minimal numbers occurring in winter (mean, 3,900 phototrophs/g of dry sediment). During winter and late spring, phototrophs had a patchy distribution over the high marsh sediment surface. In contrast, during late summer they had a random uniform distribution. Tidal water collected over high marsh sediment contained an average of 870 phototrophs/mL, with no significant seasonal variation. Anaerobic phototrophic bacteria also were cultured from the lower stem tissue of S. alterniflora growing in both the high (43,000 phototrophs/g of dry tissue) and creekside (49,000 phototrophs/g of dry tissue) marsh regions. Chromatium buderi, Chromatium vinosum, Thiospirillum sanguineum, Rhodospirillum molischianum, and Chlorobium phaeobacteroides were the predominant anaerobic phototrophic species cultured from high marsh sediment. The two Chromatium species were dominant. (Author's abstract)
W89-00333

EFFECTS OF CO-OCCURRING AROMATIC HYDROCARBONS ON DEGRADATION OF INDIVIDUAL POLYCYCLIC AROMATIC HYDROCARBONS IN MARINE SEDIMENT SLURRIES,
Maryland Univ., Solomons. Chesapeake Biological Lab.
For primary bibliographic entry see Field 5B.
W89-00339

MECHANISMS OF DNA UTILIZATION BY ESTUARINE MICROBIAL POPULATIONS,
University of South Florida, St. Petersburg.
J. H. Paul, M. F. DeFlaun, and W. H. Jeffrey.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 7, p 1682-1688, July 1988. 3 fig, 5 tab, 33 ref. U.S. EPA Cooperative Agreement CR-813589-02-0 and NSF Grant OCE-8415605.

Descriptors: *Deoxyribonucleic acid, *Microbial degradation, *Estuarine bacteria, *Metabolism, *Biotransformation, Biodegradation, Degradation, Radioactive tracers, Ribonucleic acid, Plasmids, Enzymes, Cycling nutrients, Tritium.

The mechanisms of utilization of DNA by estuarine microbial populations were investigated by competition experiments and DNA uptake studies. Deoxyribonucleoside monophosphates, thymidine, thymine, and RNA all competed with the uptake of radioactivity from (3H)DNA in 4-h incubations. In 15-min incubations, deoxyribonucleoside monophosphates had no effect or stimulated (3H)DNA binding, depending on the concentration. The uptake of radioactivity from (3H)DNA resulted in little accumulation of trichloroacetic acid-soluble intracellular radioactivity and was inhibited by the DNA synthesis inhibitor novobiocin. Molecular fractionation studies indicated that some radioactivity from (3H)DNA appeared in the RNA (10 and 30% at 4 and 24 h, respectively) and protein (approximately 3%) fractions. The ability of estuarine microbial assemblages to transport gene sequences was investigated by plasmid uptake studies, followed by molecular probing. Although plasmid DNA was detected on filters after filtration of plasmid-amended incubations, DNase treatment of filters removed this DNA, indicating that there was little transport of intact gene sequences. These observations led to the following model for DNA utilization by estuarine microbial populations: DNA is rapidly bound to the cell surface and hydrolyzed by cell-associated and extracellular nonspecific nucleases; and DNA hydrolysis products are transported, and the products are rapidly salvaged into nucleic acids, with little accumulation into intracellular nucleotide pools. (Author's abstract)
W89-00340

EFFECTS OF PULP MILL EFFLUENT ON A BALTIC COASTAL FISH COMMUNITY,
National Swedish Environment Protection Board, Oregrund. Coastal Water Section.
For primary bibliographic entry see Field 5C.
W89-00366

DYNAMICS OF PROTISTAN CARBON AND NUTRIENT CYCLING,
Woods Hole Oceanographic Institution, MA. Dept. of Biology.
D. A. Caron, and J. C. Goldman.
Journal of Protozoology JPROAR, Vol. 35, No. 2, p 247-249, 1988. 32 ref. NSF Grants OCE-8308578 and OCE-8511283.

Descriptors: *Protozoa, *Zooplankton, *Carbon cycling, *Cycling nutrients, Trophic level, Ecosystems, Food habits, Microbiological studies, Limiting nutrients, Phosphorus, Nitrogen, Ecology.

The relationships between carbon and nutrient cycling were studied in a model predator-prey system composed of bacteria, microalgae, and an omnivorous heterotrophic microflagellate Paraphysomonas imperforata. Growth rate and carbon assimilation (gross growth efficiency of P. imperforata were unaffected by different carbon: nutrient ratio of diatom (Phaeodactylum tricornutum) or chlorophyte (Dunaliella tertiolecta) prey. N or P assimilation by P. imperforata were substantially higher when the prey were severely N-limited or P-limited, respectively, than when the prey were nutrient replete. The consequence of these high nutrient assimilation efficiencies (up to 30% higher than assimilation of carbon) was that nutrient remineralization by teh microflagellate, but not respiration, was reduced for the growth-limiting nutrient. The results indicate that assimilation and regeneration of a major nutrient by the omnivorous microflagellate P physomonas imperforata may be uncoupled from carbon utilization when that nutrient is limiting to growth. Nutrient assimilation under these conditions mayu be quite high (80-90%), resulting in the production of protozoan biomass with a C:nutrient ratio substantially lower than this ratio in the prey organism. Low regeneration efficiencies (i.e., high assimilation efficiences) for a growth-limiting nutrient would imply the necessity for several trophic steps in the food web in order to attain teh 80-90% nutrient regeneration efficiencies currently believed to exist in marine plankton communities. (Lantz-PTT)
W89-00383

PHAGOTROPHIC PHOTOTROPHS: THE ECOLOGICAL SIGNIFICANCE OF MIXOTROPHY,
Wisconsin Univ.-Milwaukee. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2H.
W89-00384

PHYSICOCHEMICAL AND GEOTECHNICAL CHARACTERISTICS OF RECENT SAGUENAY FJORD SEDIMENTS,
Laval Univ., Quebec. Dept. de Geologie.
For primary bibliographic entry see Field 2J.
W89-00390

RIVER-FORCED ESTUARINE PLUMES,
Maryland Univ., Cambridge. Horn Point Environmental Labs.
S. Y. Chao.
Journal of Physical Oceanography JPYOBT, Vol. 18, No. 1, p 72-88, January 1988. 19 fig, 1 tab, 22 ref. NSF Grants OCE-8500590 and OCE-8411052.

Descriptors: *Estuaries, *Plumes, *Rivers, Model studies, Mathematical studies, Mathematical models, Water circulation, Stratification, Salinity, Water currents.

The development, maintenance, and dissipation of river-forced estuarine plumes with and without seaward sloping bottom are studied by use of a three-dimensional, primitive-equation model. Inside the estuary, discussion is focused on how the Coriolis force induces lateral asymmetries in the circulation. Four physical processes dictate the transient as well as the quasi-steady circulation in moderately stratified estuaries: (1) upper-layer convergence during the transient spinup phase; (2) upward entrainment leading to the two-layer steady circulation pattern; (3) upward stretching of the lower-layer vortex during the spindown period; and (4) in the presence of a seaward bottom slope, the left-bounded tendency of the landward undercurrent for all phases of development. Deviations from the laterally averaged circulation pattern caused by these processes are discussed. Over the shelf, various types of plumes are defined according to the visual appearance of the surface salinity field. The four types of plumes, namely, the supercritical, subcritical, diffusive-supercritical, and diffusive-subcritical are classified by an empirical Froude number and another dimensionless parameter indicating the amount of dissipation acting on density currents. (Author's abstract)
W89-00414

SHEAR INSTABILITY IN A HIGHLY STRATIFIED ESTUARY,
Woods Hole Oceanographic Institution, MA.
W. R. Geyer, and J. D. Smith.
Journal of Physical Oceanography JPYOBT, Vol. 17, No. 10, p 1668-1679, October 1987. 9 fig, 1 tab, 27 ref. NSF Contract OCE-83-08586.

Descriptors: *Shear stress, *Estuaries, *Stratification, *Density stratification, Saline waters, Mathematical studies, Stratified flow, Water currents, Mixing, Model studies, Mathematical models, Shear, Pycnocline.

Shear instability is found to be the principal mechanism of vertical exchange within the pycnocline of a salt wedge estuary. A field program involving high-resolution velocity and density measurements, as well as high-frequency acoustic imagery, allowed direct comparison of instantaneous Richardson number distributions to the occurrence of shear instability. The theoretical stability threshold of 0.25 is consistent with the measurements, based on estimates of gradients that contain the mean as well as fluctuations due to internal waves. An effective stability threshold based on mean gradients is found to be approximately one-third, reflecting a significant contribution of internal wave shear. The integral effect of the mixing process is to homogenize the gradients of velocity and density, producing linear profiles of these quantities across the pycnocline. A turbulent Prandtl number of unity is suggested by the vertical distributions of velocity and density during periods of active vertical mixing. Based on these observations, a simple model for mixing in stratified shear flows is proposed, which is applicable to estuaries and other environments with a dominant mean shear. (Author's abstract)
W89-00415

FLUX OF ORGANIC CARBON IN A TIDAL SALT MARSH, KOWIE RIVER ESTUARY, PORT ALFRED, SOUTH AFRICA,
Rhodes Univ., Grahamstown (South Africa). Dept. of Zoology and Entomology.
M. J. Kokkinn, and B. R. Allanson.
South African Journal of Science SAJSAR, Vol. 81, No. 10, p 613-617, October 1985. 6 fig, 2 tab, 22 ref.

Descriptors: *Carbon cycle, *Organic carbon, *Salt marshes, *Estuaries, *Kowie River, *South Africa, Water currents, Tides.

The Port Alfred salt marsh is connected to the estuary of the Kowie River by a single culvert. It offered, consequently, an ideal opportunity to investigate tidal hydraulics and to measure carbon flow between the two water bodies. A striking tidal asymmetry was found between the ebb (0.30 cu m/sec) and flood (0.90 cu m/sec) tides. The most important factors in influencing tide height were regional wind direction and velocity. Three forms of suspended and dissolved organic carbon were monitored over two tidal cycles: fine particular organic carbon, coarse particulate organic carbon and dissolved organic carbon. The results reveal that imported carbon was roughly double the amount exported during each tidal cycle. Evidence of substantial organic carbon import by coastal salt marshes from the tidal river at certain times of year runs contrary to the paradigm which holds salt marshes to be prolific energy exporters. (Author's abstract)
W89-00453

FLUVIAL SEDIMENTATION IN THE EBB-DOMINATED ORANGE ESTUARY,
National Research Inst. for Oceanology, Stellenbosch (South Africa). Marine Geoscience Div.
For primary bibliographic entry see Field 2J.
W89-00456

SPATIAL PATTERNS OF N FIXATION (ACETYLENE REDUCTION) ALONG ENVIRONMENTAL GRADIENTS IN A WARM-TEMPERATE ESTUARY,
Port Elizabeth Univ. (South Africa). Dept. of Botany.
M. M. B. Talbot, J. G. C. Small, and G. C. Bate.
Journal of Experimental Marine Biology and Ecology JEMBAM, Vol 117, No. 3, p 255-270, June 14, 1988. 7 fig, 1 tab, 47 ref.

Descriptors: *Estuarine environment, *Nitrogen fixation, *Acetylene reduction, *Environmental gradient, *Temperate zone, *South Africa, Spatial distribution, Salt marshes, Spartina, Intertidal areas, Organic carbon.

Nitrogen-fixation patterns in the salt marshes of the Swartkops Estuary, Republic of South Africa, were established by investigating acetylene reduction activity (ARA) along four gradients. Most sites investigated showed high levels of ARA. Surface-sediment and rhizosphere ARA were mainly found in the middle regions of the intertidal which correlate with high organic C and moisture levels. Activity along Spartina maritima tillers showed >98% restricted to the stem region. The Spartinetum Community was the major contributor of fixed N to the salt marsh and appears to be responsible for the marsh acting as an exporter of N to Algoa Bay, South Africa. (Author's abstract)
W89-00475

EFFECT OF MANGROVE HUMIC-LIKE SUBSTANCES ON BIODEGRADATION RATE OF DETRITUS,
Universidad Nacional Autonoma de Mexico, Mexico City. Inst. de Ciencias del Mar y Limnolo-

gia.
F. Gonzalez-Farias, and L. D. Mee.
Journal of Experimental Marine Biology and Ecology JEMBAM, Vol 119, No. 1, p 1-13, July 5, 1988. 3 fig, 3 tab, 44 ref.

Descriptors: *Mangrove swamps, *Biodegradation, *Detritus, *Decomposing organic matter, *Humic acids, White mangrove, Leaves, Statistical analysis, Chromatography, Tropical regions, Coastal waters, Tannins, Heterotrophic bacteria, Inhibitors.

Laboratory measurements were made of the degradation of white mangrove, Laguncularia racemosa, senesced leaves in the presence of various initial concentrations of substances obtained from the leaves. The control leaves presented an average degradation rate (K = -1.33 per yr) that was statistically different ($P < 0.05$) to that of the leaves degraded in the presence of humic-like substances (K = -0.89 per yr). Chromatographic characterization of the humic-like substances was performed and the chromatograms were compared with those of the humic substances isolated from a tropical coastal lagoon and with tannins from mangrove leaves. The chromatogram of tannins showed two peaks, one of high-molecular-weight (>2000) compounds and another of low-molecular-weight (approximately 200) compounds that are probably condensed and hydrolyzed tannins. The chromatogram of the lagoon humics showed a predominance of high-molecular-weight compounds, as compared with that of the humic-like substances which showed both peaks. This difference is probably due to the humification processes that take place in the lagoon. To evaluate the influence of these compounds on the biodegradation of mangrove detritus, the inhibitory activity was measured both as combined and selected chromatographic fractions, using heterotrophic bacteria from the lagoon. The tannins, humic-like substances, and lagoon humics presented strong inhibitory activity. It is suggested that these compounds are responsible for a negative feedback between the input of detritus to the lagoon and its biodegradation. (Author's abstract)
W89-00476

EFFECTS OF SEDIMENT NUTRIENTS ON SEAGRASSES: LITERATURE REVIEW AND MESOCOSM EXPERIMENT,
New Hampshire Univ., Durham. Jackson Estuarine Lab.
F. T. Short.
Aquatic Botany AQBODS, Vol. 27, No. 1, p 41-57, January 1988. 2 fig, 6 tab, 74 ref.

Descriptors: *Seagrasses, *Nutrients, *Sediments, Aquatic plants, Plant morphology, Plant physiology, Geochemistry, Estuarine environment, Limiting nutrients, Nitrogen, Ammonium.

A review of the literature showed that seagrass growth, abundance and morphology were strongly linked to available nutrient resources. In north temperate climates and in habitats with terrigenous sediments, nitrogen limitation occurred in both intertidal and subtidal beds. Typically, seagrasses growing in terrigenous sediments have ample phosphorus but lack nitrogen, and the plants' chemical composition was depleted in nitrogen. However, seagrasses occurring in tropical environments and carbonate sediments appeared to experience phosphorus limitation due to binding of phosphate in the sediments. Thus, it was the sediment geochemistry in seagrass beds that was important in determining the limiting nutrient to seagrass growth. Examination of the literature indicated that field research on seagrass relationships involved too many interactive factors to be able to say certainly that any one plant characteristic was caused by any one environmental factor. Using mesocosms (partially enclosed outdoor experimental set-ups) one environmental factor can be changed between the treatment tank and the control. Therefore, it can be determined experimentally that a plant characteristic was affected by a particular altered environmental factor. Experimental mesocosms used to grow eelgrass, Zostera marina L., in substrata of varied nitrogen composition showed the dramatic effect of insufficient nitrogen on eelgrass growth, abundance and leaf morphology. Additionally, eelgrass leaf tissue from low ammonium sand substratum was significantly depleted in nitrogen, demonstrating the supposition that nitrogen was limiting in terrigenous environments. (Author's abstract)
W89-00523

DECOMPOSITION OF ROOTS OF THREE PLANT COMMUNITIES IN A DUTCH SALT MARSH,
Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
G. J. C. Buth.
Aquatic Botany AQBODS, Vol. 29, No. 2, p 123-138, October 1987. 3 fig, 4 tab, 37 ref.

Descriptors: *Aquatic plants, *Salt marshes, *Decomposition, Plant populations, Spartina, Puccinellietum, Halimionetum, Roots Biomass, Flooding, Environmental effects, Comparative studies, Netherlands.

Results of the first published study on root decomposition in a West European salt marsh are presented. In situ decomposition of roots of Spartinetum, Puccinellietum and Halimionetum communities were investigated using litter bags. Both the temporal pattern of decomposition and decomposition rate of belowground tissues of the three communities differed during 30 weeks in the marsh; Puccinellietum root litter lost 30-45% ash-free dry weight, Halimionetum root litter 17-26% and Spartinetum root litter 7-17%. Compared to aboveground decomposition in salt marshes these rates are low, however they are in the range of results reported for American and Australian salt marshes. Decomposition rates of root material buried at depths of 10 and 20 cm differed and there was a community X depth interaction. Initial content of structural components was highest in Halimionetum root litter and lowest in Puccinellietum root litter. Integrated soil temperature was highest in the Puccinellietum habitat, while flooding frequency was lowest in the Halimionetum habitat. Results indicate that environmental conditions can cause irregular fluctuations in belowground decomposition rates. (Author's abstract)
W89-00527

POPULATION DYNAMICS OF A TROPICAL INTERTIDAL AND DEEP-WATER POPULATION OF SARGASSUM POLYCERATIUM (PHAEOPHYCEAE),
Groningen Rijksuniversiteit (Netherlands). Dept. of Marine Biology.
E. D. De Ruyter Van Steveninck, and A. M. Breeman.
Aquatic Botany AQBODS, Vol. 29, No. 2, p 139-156, October 1987. 15 fig, 3 tab, 42 ref. Netherlands Foundation for the Advancement of Tropical Research Contract (WOTRO) W84-201.

Descriptors: *Phaeophyta, *Population dynamics, *Intertidal areas, Plant populations, Primary productivity, Biomass, Plant Growth, Seasonal variation, Storms, Netherlands Antilles.

Plant numbers, plant size, number and length of primary laterals, reproduction, growth rates and turnover rates were recorded for an intertidal and a deep-water (30 m depth) population of Sargassum polyceratium Montagne at Curacao, Netherlands Antilles, for 1.5 years. Both populations showed distinct seasonal variations in biomass and growth rates, with maxima in late summer-early autumn and minima in winter. The observed fluctuations were probably amplified by a severe autumn storm that significantly reduced biomass in both populations at the end of the first year. The main differences between the populations were a more compact growth form and higher growth rates and turnover rates of primary laterals in the intertidal population. (Author's abstract)
W89-00528

FACTORS INFLUENCING ABOVEGROUND PRODUCTION OF SCIRPUS MARSHES IN THE ST. LAWRENCE ESTUARY, QUEBEC, CANADA,
Laval Univ., Quebec. Dept. de Biologie.
J.-F. Giroux, and J. Bedard.
Aquatic Botany AQBODS, Vol. 29, No. 3, p 195-204, December 1987. 4 tab, 27 ref. Canadian Wildlife Service (contract OSD82-00009 with the Ministry of Supply and Services).

Descriptors: *Aquatic plants, *Primary productivity, *Estuaries, *Tidal marshes, Macrophytes, Biomass, Sediments, Environmental effects, Statistical analysis, St. Lawrence Estuary.

Aboveground production of macrophytes in tidal marshes was studied for 3 years at Montmagny and Cap St. Ignace on the south shore of the St. Lawrence River in Quebec, Canada. Year-to-year variation of production of the dominant species, Scirpus americanus Pers., was observed and related to variation in weather during the growing season. With the exception of Zizania aquatica L., relative production of the macrophytes for different parts of the marshes remained constant in successive years. A multiple regression procedure was used to establish the relationship between production and a series of independent variables including biotic (goose use and plant competition) and abiotic factors (submersion, substrate hardness, soil texture and sedimentation). A lower percentage of organic matter in the soil and a firm substrate were associated with a greater production of S. americanus. Accretion of sediments was positively correlated with the production of S. americanus and Sagittaria spp., whereas the percentage of time of submersion was negatively related with production of Sagittaria spp., Eleocharis spp. and Scirpus torreyi Olney. Competitive interference was apparent between S. americanus and S. torreyi Olney and between Eleocharis spp. and Zizania spp. No measured abiotic characteristic of the marsh explained the variation of Zizania production. (Author's abstract)
W89-00529

DETERMINATION OF GROSS-BETA RADIOACTIVITY IN WATER OF THE CHANGJIANG RIVER AND SEA WATER NEAR ITS ENTRANCE TO SEA, (IN CHINESE),
Academia Sinica, Qingdao (China). Inst. of Oceanology.
For primary bibliographic entry see Field 2H.
W89-00534

EXTRACTION AND DETERMINATION OF CHLOROPHYLL FROM BENTHIC GREEN ALGAE WITH DIMETHYL SULFOXIDE, (IN CHINESE),
Academia Sinica, Qingdao (China). Inst. of Oceanology.
For primary bibliographic entry see Field 7B.
W89-00539

STUDIES ON MARINE HUMIC SUBSTANCES: III. THE DISTRIBUTION OF HUMIC SUBSTANCES IN SEAWATER AND SEDIMENTS IN THE ESTUARY OF CHANGJIANG RIVER AND EAST CHINA SEA, (IN CHINESE),
Academia Sinica, Qingdao (China). Inst. of Oceanology.
C. Wenda, J. Minghou, Q. Xiangquan, and H. Lijun.
Oceanologia et Limnologia Sinica OECOBX, Vol. 18, No. 5, p 459-468, September 1987. 7 fig, 4 tab, 11 ref. English summary.

Descriptors: *Estuaries, *Humic acids, *Water analysis, *Seawater, *Sediments, Decomposing organic matter, Phytoplankton, Marine sediments, Particle size, Changjiang River Estuary, China, East China Sea.

Methods for determining the concentrations of humic substances in seawater and sediments are described. These methods were used to investigate the quantities of humic substances in the seawater and sediments of the Changjiang River estuary and East China Sea. Comprehensive investigations were made from 1981 to 1983. Concentrations of the humic substances at the surface layer seawater of the Changjiang River estuary area west of 124

deg E varied from 150 micrograms/L to 435 micrograms/L. Concentrations of the humic substances decreased gradually from the estuary of the Changjiang River towards the outer sea, and there were inverse correlations between concentrations and S. Concentrations of the humic substances at the surface of the East China Sea area east of 124 deg E varied from 100 micrograms/L to 150 micrograms/L. Near the Ryukyu Islands the concentrations of humic substances were below 100 micrograms/L. There are relatively close correlations between the concentrations of humic substances in the seawater and the distribution of phytoplankton in the area of the Changjiang River estuary. The contents of humic substances in the sediments from the Changjiang River estuary and East China Sea varied from 0.416 mg/g to 3.371 mg/g. Contents of the humic substances are more than 3 mg/g, which are higher than those at other areas. There are direct and close correlations between the grain size of the sediments and the contents of the humic substances. The smaller the grain size of the sediments, the higher the contents of the humic substances. (See also W89-00545) (Author's abstract)
W89-00541

NUMERICAL SIMULATION ON TYPHOON SURGE AND SURGE ESTIMATION OF HUANGHE RIVER ESTUARY REGION IN BOHAI SEA, (IN CHINESE),
Academia Sinica, Qingdao (China). Inst. of Oceanology.
D. Wenlan, and L. Fengshu.
Oceanologia et Limnologia Sinica OECOBX, Vol. 18, No. 5, p 481-490, September 1987. 6 fig, 1 tab, 4 ref. English summary.

Descriptors: *Bohai Sea, *Estuaries, *Storms, *Mathematical studies, *Storm surges, *China, Typhoons, Surges, Simulation analysis, East China Sea, Yellow Sea, Huanghe River Estuary.

The hydrodynamic numerical method was used to simulate typhoon surges of three typical tracks in the Bohai Sea. The results coincide with observations. When the typhoon is in the East China and Yellow seas or has crossed the Bohai Sea, the angle between the wind direction of the Jelesnianski wind field and the direction of the geostrophic wind is phi = 15 deg; the angle of the isobar and concentric circles is lambda = 0. When the typhoon has moved into or along the east of the Bohai Sea, the circular wind field effect of the typhoon becomes more obvious and the value of lambda increases as the distance increases from the typhoon center. From Tanggu to Senxiangou, when the travelling speed of the typhoon is in the range of 3 - 9 m/sec, the maximum surge decreases as the travelling speed increases. But when the travelling speed is between 9 and 15 m/sec, the maximum surge decreases as the travelling speed increases. The maximum surges occurred for the first time in Laizou Bay. Then the crest of the surge propagated from north to south along the west coast around the center of the Bohai Sea and appeared to move in a counterclockwise direction. This was due to the influence of the Coriolis force. On the basis of numerical simulation, 10 typhoon tracks were chosen for study and the travelling speed of each typhoon estimated at 9.82 and 12.27 m/sec, respectively. The wind velocities were estimated at the following speeds: 15, 20, 25, 30 and 35 m/sec, respectively. The maximum surges at 12 places in the nearshore of Huanghe River Delta were determined. The tests showed that the typhoon has the most effect on the storm surges of the Huanghe River Estuary along the I2 track. (Author's abstract)
W89-00543

CHROMIUM SPECIATION IN THE HUANGHE RIVER AND ITS ESTUARINE REGION, (IN CHINESE),
Academia Sinica, Qingdao (China). Inst. of Oceanology.
For primary bibliographic entry see Field 5B.
W89-00544

STUDIES ON MARINE HUMIC SUBSTANCES: IV. THE DISTRIBUTION OF HUMIC SUBSTANCES IN THE SEAWATER AND SEDIMENTS OF HUANGHE RIVER ESTUARY, (IN CHINESE),
Academia Sinica, Qingdao (China). Inst. of Oceanology.
C. Wenda, Q. Xiangquan, and H. Lijun.
Oceanologia et Limnologia Sinica OECOBX, Vol. 18, No. 6, p 606-612, November 1987. 6 fig, 3 tab, 6 ref. English summary.

Descriptors: *Seawater, *Estuaries, *Sediments, *Humic acids, *China, Decomposing organic matter, Marine sediment, Particle size, Seasonal variation, Huanghe River Estuary.

Concentrations of humic substances and alcohol-soluble organic matter in seawater from the Huanghe River estuary are influenced by the Huanghe River current. Their concentrations are inversely related to S (0/00) with the correlation coefficients of -0.93 and -0.89 in May, -0.96 and -0.75 in August, respectively. Average concentrations of the humic substances and alcohol-soluble organic matter in the seawater also vary with the season, 433.0 micrograms/L and 597.2 micrograms/L in August, 385.2 micrograms/L and 580.7 micrograms/L in May, respectively. Both concentrations in August are higher than those in May. Contents of the humic substances in the sediments of the Huanghe River estuary vary from 0.791 mg/g to 1.534 mg/g, averaging 1.128 mg/g. Their content distributions are related to the grain size of the sediments. The fine grained matter contains more of the humic substances. (See also W89-00541) (Author's abstract)
W89-00545

ENVIRONMENTAL CONDITIONS IN ABU KIR BAY, EAST OF ALEXANDRIA: I. PHYSICO-CHEMICAL CHARACTERISTICS AND WATER CIRCULATION,
Alexandria Univ. (Egypt). Dept. of Oceanography.
For primary bibliographic entry see Field 5B.
W89-00565

TWO TOXICANTS, MERCURY AND TIN IN THE GULF OF ISKENDERUN,
Middle East Technical Univ., Ankara (Turkey). Inst. of Marine Sciences.
For primary bibliographic entry see Field 5B.
W89-00570

BACTERIOLOGICAL CONTAMINATION OF THE EASTERN PART OF THE GULF OF TRIESTE (NORTH ADRIATIC) DUE TO SEWAGE DISCHARGE,
Ljubljana Univ. (Yugoslavia). Biological Inst.
For primary bibliographic entry see Field 5B.
W89-00577

TROPHIC STATE GRADIENTS AND ZOOPLANKTON AND ZOOBENTHOS DISTRIBUTION IN A PO RIVER DELTA LAGOON,
Ferrara Univ. (Italy). Ist. di Zoologia.
V. U. Ceccherelli, V. Gaiani, and I. Ferrari.
Chemosphere CMSHAF, Vol. 16, Nos. 2/3, p 571-580, 1987. 6 fig, 1 tab, 19 ref.

Descriptors: *Aquatic habitats, *Estuaries, *Po River, *Trophic state, Italy, Deltas, Zooplankton, Benthos, Sediments, Invertebrates, Benthic invertebrates, Habitats, Lagoons.

The Sacca di Scardovari, a large lagoon in the Po River Delta, was the site of water, sediment, and fauna studies. The 32-sq-mi body of water is inundated by high tides on its southern border. Salinity variations were higher at the southern end. Temperature variations were greater in the northern end (inner zone). A tendency toward a higher trophic state from south to north was noted in results of studies of dissolved oxygen, nutrients, and chlorophyll a. Sediments became increasingly coarse from north to south (clay to silt-clay to sand). Higher organic matter and nitrogen levels were found in sediments in the north. The inner zone also contained a zooplankton population of higher density and biomass than the southern zone. In the north, brackish rotifers and larvae of polychaetes, molluscs and Cirripedes were common; in the south, typical river plankton and marine forms. The macrobenthos community was dominated in the north by Capitella capitata; in the central-southern zone by the polychaetes, Polydora ciliata and Heteromastus filiformis, and the bivalves, Cerastoderma glaucum and Abra ovata. Two unique subcommunities were also found--one characterized by Crassostrea sp., Nereis succinea, Ficopomatus enigmaticus, and Melita palmata; the other typical of sublittoral sea bottoms lying in front of the delta. (Cassar-PTT)
W89-00580

DEGRADATION OF BISPHENOL A IN NATURAL WATERS,
Shell Development Co., Houston, TX.
For primary bibliographic entry see Field 5B.
W89-00600

BIOTIC AND ABIOTIC DEGRADATION RATES OF METHYL PARATHION IN FRESHWATER AND ESTUARINE WATER AND SEDIMENT SAMPLES,
Environmental Protection Agency, Gulf Breeze, FL. Gulf Breeze Environmental Research Lab.
For primary bibliographic entry see Field 5B.
W89-00601

MONITORING OF PCDDS IN OSAKA BAY USING BLUE MUSSEL,
Setsunan Univ., Neyagawa (Japan). Faculty of Pharamaceutical Sciences.
For primary bibliographic entry see Field 5B.
W89-00604

CHLORINATED HYDROCARBONS IN SEDIMENTS OF THE ELBE RIVER AND THE ELBE ESTUARY,
Alfred-Wegener-Inst. fuer Polarforschung, Bremerhaven (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W89-00614

GEOMORPHOLOGY, OFFSHORE BATHYMETRY AND QUATERNARY LITHOSTRATIGRAPHY AROUND THE BOT RIVER ESTUARY,
Geological Survey of South Africa, Bellville.
J. Rogers.
Transactions of the Royal Society of South Africa, Vol. 45, Parts 3 and 4, p 211-237, July 1985. 13 fig, 40 ref, append.

Descriptors: *Estuaries, *Geomorphology, *Stratigraphy, *Bot River Estuary, *Paleohydrology, *Sedimentology, *South Africa, *Estuarine sediments, Succession, Sand, Mud, Foraminitera, Organic matter, Estuarine environment, Bottom sediments, Lagoons, Quartz.

The Quaternary sediments around the margin of the Bot River's closed estuary have been drilled and a succession up to 52 m thick has been analyzed sedimentologically. Four main units have been identified. The basal Unit 1 is a 10-m thick, angular, quartzose coarse gravelly mud, rich in fragments of rock and vein quartz, and is mainly encountered in the palaeo-valley under the barrier. It is interpreted as a fluvial basal gravel deposited during the early stages of a Wurm IIa/IIb transgression. Unit 2 is 15 to 30 m thick and is consistently muddy (muddy sand to mud). It is characterized by benthic foraminifera typical of inner-shelf or estuarine environments and is interpreted as a back-barrier lagoonal sediment deposited during the latter stages of the Wurm IIa/IIb transgression. Due to compaction and its subsequent cohesiveness, Unit 2 survived re-excavation during the Wurm IIb regression to -130 m, when the mouth of the palaeo-Bot River lay south of False Bay, between the Hangklip Ridge and Betty's Bay Bank. Unit 3 overlies Unit 2 in BOT-103 at Die Keel and is a 12 m-thick shelly, fine to medium sand. Unit 4 is 5 to 15 m thick and is a quartzose, medium sand under the barrier. Farther inland it can be a sandy mud and the unit can be rich in organic matter.

Unit 4 was laid down during the Flandrian transgression. Unit 5 is the 15 to 30 m-thick calcareous, quartzose medium sand of the barrier environment that is found on the beach, on the dunes and also on the washover fans that are periodically fed by storm-surges breaching the foredunes. There is evidence of a post-glacial (5,500-2000 yr B.P.) barrier slightly inshore of the present coast and of a Late Pleistocene (125,000 B.P.) shoreline beside the Lamloch swamps. (See W89-00650 thru W89-00666) (Author's abstract)
W89-00649

BARRIER/ESTUARINE PROCESSES. BOT RIVER ESTUARY: AN INTERPRETATION OF AERIAL PHOTOGRAPHS,
Specialist Offshore Surveys Pty Ltd., Newlands (South Africa).
I. van Heerden.
Transactions of the Royal Society of South Africa, Vol. 45, Parts 3 and 4, p 239-251, July 1985. 6 fig, 15 ref.

Descriptors: *Estuaries, *Bot River Estuary, *Geomorphology, *Sediment transport, *Aerial photography, *South Africa, *Sedimentology, Estuarine environment, Subsidence, Wind, Sea level, Succession, Barriers, Dunes.

The Bot River estuary can be classified as an end-member stage of a bar-built estuary, occupying a drowned river valley. The modern barrier consists of fairly large back-barrier dunes, hummocky foredunes and a dissipative beach. Aerial photographs were interrupted to assess whether the estuary during modern times always has had its present configuration, and to interpret the present physical processes based upon changing morphological features. Lowering of sea-level following the Late Holocene high-water stand exposed a sandy strand plain between Kleinmond and Hawston. Wind action forced an eastward transport of these sands creating a large dune field between Sonesta and Hawston, and a deflation surface at Rooisand. In 1938 the Lamloch swamps were well vegetated, but by 1981 large, formerly vegetated areas had been converted to open water as a result of subsidence. Long periods of mouth closure forced high water-levels in the estuary that flooded the deflated Rooisand area. Eventually estuarine waters made their way into the subsiding Lamloch swamp via two distinct pathways. Creation of the two channels reflects the natural adjustment of the water bodies to closure of the estuary mouth. Conceivably, barring man's intervention, the system could revert back to an estuary experiencing more regular marine interchange. The estuary then would consist of a brackish coastal lake connected by a sinuous estuary (Lamloch and Rooisand areas) to the sea at Kleinmond. The modern barrier is prograding landward into the estuary due to sediment introduced during washovers. Barrier accretion is enhanced when the barrier fronting the estuary is artificially breached. (See also W89-00649) (Author's abstract)
W89-00650

BATHYMETRY, ENVIRONMENTAL PARAMETERS AND SEDIMENTS OF THE BOT RIVER ESTUARY, S.W. CAPE PROVINCE.
Cape Town Univ. (South Africa). Dept. of Geochemistry.
J. P. Willis.
Transactions of the Royal Society of South Africa, Vol. 45, Parts 3 and 4, p 253-283, July 1985. 25 fig, 2 tab, 14 ref.

Descriptors: *Bot River Estuary, *Estuaries, *Estuarine environments, *Bathymetry, *Bottom sediments, Water level, Winds, Currents, Wave action, Sedimentology, Water level fluctuations, Estuarine environment, Succession, Quartz, Sand, Minerals, South Africa.

The bathymetry of the Bot River estuary, water-level records from 1978 to 1983, wind records for a three-week period in August-September 1984, and investigations into the particle-size distribution, mineralogy and chemical composition of sediments in the estuary are reported and discussed. The Bot River estuary is generally shallow, too shallow for the development of a halocline. The water-levels fluctuate between approximately 0.2 m and 2.7 m above mean sea-level. Water-flow through an overflow channel into the Lamloch swamps, during periods of high water-level, is sufficient to lower the water-level by 0.11 m per week, assuming no inflow. This is probably the main factor preventing the estuary from opening naturally to the sea. From August to October 1984, wind speeds exceeded 25 km/h approximately 15-20% of the time, and blew from the north, west and east for approximately equal proportions of the time. The sediments in the estuary are mainly sands (51%) or muds (33%). There is a marked lack of very fine sand in the estuary, and the mean particle size is medium sand. The sand consist mainly of quartz, except in the lower reaches near the sea where they contain a high proportion of shell fragments. The compositions of the muds in the central mud belt are remarkably homogeneous, and probably reflect through mixing of the finer particles by the resuspension caused by wind-generated wave and current action on the sediments. The sediments in the estuary consist of quartz alone, or simple mixtures of quartz and carbonates (shell fragments) or quartz and clay minerals (with some organic matter). Only 4 out of 199 sediment samples show any mixing of carbonates with clay minerals. (See also W89-00649) (Author's abstract)
W89-00651

NUMERICAL MODEL FOR THE WIND-DRIVEN CIRCULATION IN THE BOT RIVER ESTUARY,
Cape Town Univ. (South Africa). Dept. of Oceanography.
D. van Foreest.
Transactions of the Royal Society of South Africa, Vol. 45, Parts 3 and 4, p 285-289, July 1985. 3 fig, 4 ref.

Descriptors: *Estuaries, *Model studies, *Wind waves, *Wind-driven currents, *Bot River Estuary, *Sediment transport, *Lake sediments, *South Africa, Wind, Water circulation, Lagoons, Mathematical models, Hydraulic models, Water currents.

A numerical model for the wind-driven circulation of the Bot River estuary was run for various wind-directions and the resulting current patterns are discussed. Using a wind-stress of 3 dynes/sq cm in all cases, the model was run for various wind conditions, including northeasterly and south-southeasterly winds with drag coefficients of 0.0025 and 0.025. In all cases, relatively strong currents are present along the boundaries of the estuary with weak return currents in the central, deeper parts. This circulation pattern suggests that sediments could be removed from the shallow water along the edge of the estuary and deposited in the central parts. The circulation patterns that resulted from the model depend upon the detail of the wind-field. If the model is to be pursued, it will be essential to obtain detailed information on the dominant wind directions and the spatial variability of the wind field. Direct current measurements are needed to 'tune' the model. (See also W89-00649) (Friedmann-PTT)
W89-00652

HISTORICAL RECORDS OF THE BOT RIVER ESTUARINE SYSTEM,
Cape Town Univ. (South Africa). Dept. of Zoology.
R. Bally.
Transactions of the Royal Society of South Africa, Vol. 45, Parts 3 and 4, p 291-303, July 1985. 4 fig, 23 ref, append.

Descriptors: *Estuaries, *Bot River Estuary, *South Africa, *History, *Succession, *Geomorphology, Flushing, Maps, Kleinmard Estuary, Water level, Breaching, Topography.

Historical evidence shows that the Bot River estuarine system (South Africa) has undergone substantial topographical changes during the past century, the most recent being the partial isolation of the Kleinmond from the Bot River estuary, of which it was once apparently a part. Despite these substantial changes, there is no evidence to confirm an early newspaper report that the estuary itself was used as a harbor. The historical evidence that is reliable shows that the connection with the Kleinmond estuary has varied considerably in the past, possibly in a cyclical manner. The ease of water-flow between the Bot and Kleinmond estuaries would strongly affect both the likelihood of a natural opening occurring (if the flow is restricted, water-levels in the Bot would remain at heights conducive to breaching for longer) and also the flushing process described by Bally and McQuaid. (See also W89-00649) (Friedmann-PTT)
W89-00653

HYDROLOGY OF THE BOT RIVER ESTUARY,
National Research Inst. for Oceanology, Stellenbosch (South Africa).
G. A. W. Fromme.
Transactions of the Royal Society of South Africa, Vol. 45, Parts 3 and 4, p 305-315, July 1985. 3 fig, 10 ref.

Descriptors: *Estuaries, *Estuarine environment, *Floods, *Bot River Estuary, *Breaching, *Water level fluctuations, *South Africa, *Saline-freshwater interfaces, Sea level, Lagoons, Silt.

During the flood year of 1981 and 1983, the Bot River estuary (South Africa), one of the largest lagoons in the southwestern Cape, was opened to the sea by three artificial breachings of the sand bar that were aimed at lowering the excessively high water levels in the lagoon and at the re-establishment of estuarine conditions. Surveys were undertaken in the lagoon and at the mouth channels in an attempt to formulate a future viable management policy, taking into account the conflicting interests of the defenders of continued artificial breachings and of those who advocate a closed estuary which, if left unbreached, will eventually change into a coastal fresh-water lake. Artificial breachings cause a rapid lowering of the water level in the vlei associated with a sudden loss of large areas of water surface; they also lead to the effective discharge of silt-laden flood waters and an influx of clear seawater. It is recommended that breachings only be done after the vlei has reached a water-level of more than mean sea level + 2 m, and at the peak of the rainy winter season, to ensure that the mouth remains open for a reasonable period of time. (See also W89-00649) (Author's abstract)
W89-00654

PHYSICAL AND CHEMICAL CHARACTERISTICS OF THE WATERS OF THE BOT RIVER ESTUARY, SOUTH AFRICA,
Cape Town Univ. (South Africa). Dept. of Zoology.
R. Bally, and C. D. McQuaid.
Transactions of the Royal Society of South Africa, Vol. 45, Parts 3 and 4, p 317-331, July 1985. 6 fig, 3 tab, 30 ref.

Descriptors: *Estuaries, *Bot River Estuary, *Water chemistry, *South Africa, Hydrogen ion concentration, Breaching, Dunes, Lagoons, Water properties, Estuarine environment, Chemical properties, Physical properties, Salts, Sodium, Sulfate, Ammonia, Phophates, Silicates, Flushing, Chlorine, Alkalinity, Water temperature, Saline-freshwater interfaces, Seasonal variation.

The physical and chemical properties of waters of the Bot River estuary have been examined over a period of five years. The parameters measured were: electrical conductivity, pH, alkalinity, temperature, dissolved oxygen, total dissolved salts, sodium, magnesium, calcium, potassium, fluoride, chloride, nitrate, ammonia, sulfate, phosphate and silicate. The physical and chemical properties of the Bot River estuary during the period under consideration were dominated by two processes. The first of these was the input of marine water by artificial breaching of the dune barrier that normally impounds the estuary. The second process was the gradual dilution and flushing of this marine water by water draining into the estuary from the catchment, and out of the system at times of high

water by means of a connection with the neighboring Kleinmond estuary. These two processes were modulated by seasonal changes. (See also W89-00649) (Author's abstract)
W89-00655

PRIMARY PRODUCTIVITY OF THE BOT RIVER ESTUARY, SOUTH AFRICA,
Cape Town Univ. (South Africa). Dept. of Zoology.
R. Bally, C. D. McQuaid, and S. M. Pierce.
Transactions of the Royal Society of South Africa, Vol. 45, Parts 3 and 4, p 333-345, July 1985. 4 fig, 52 ref.

Descriptors: *Estuaries, *Estuarine environments, *Primary productivity, *Bot River Estuary, *South Africa, *Ecosystems, Macrophytes, Benthic fauna, Biomass, Phytoplankton, *Aquatic populations, Diatoms, Bottom sediments, Breaching, Organic matter, Submerged plants, Reeds, Aquatic bacteria, Lagoons, Flushing.

The primary production of the Bot River estuary, a large closed estuary on the southwestern coast of South Africa, has been estimated at 11,059 t dry mass/year. The main contributions to this value come from the submerged aquatic macrophytes (7,987 t dry mass/y or 72% of total calculated production), reeds (1,503 t dry mass/year or 14%), benthic diatoms (787 t dry mass/y or 7%) and phytoplankton (782 t dry mass/y or 7%). These four categories are believed to contribute over 90% of the primary production during periods of stability when the estuary is closed and full. Much of this production is not directly utilized by herbivores and forms the basis of a bacterial system producing very fine, organically rich material deposited on the estuary bed. Primary production is affected by mouth opening in a number of different ways including changes in volume of water, available surface area for attachment of macrophytes, and loss of macrophytes that are stranded or washed out to sea. (See also W89-00649) (Author's abstract)
W89-00656

EFFECT OF SALINITY AND TEMPERATURE VARIATIONS ON THE BACTERIAL POPULATION IN THE BOT RIVER ESTUARY,
Cape Town Univ. (South Africa). Dept. of Zoology.
C. H. Roberts, G. M. Branch, and F. T. Robb.
Transactions of the Royal Society of South Africa, Vol. 45, Parts 3 and 4, p 347-351, July 1985. 2 fig, 2 tab, 6 ref.

Descriptors: *Estuaries, *Water temperature, *Salt tolerance, *South Africa, *Bot River Estuary, *Aquatic bacteria, Population exposure, Growth rates, Salinity, Saline water, Estuarine environment, Water currents, Aquatic populations, Population dynamics, Bacteria.

The effect of temperature and salinity variations on the suspended bacterial population of the Bot River estuary, a closed estuary, was examined. The population was salt-tolerant, and saline water was required for maximal growth rates. Temperatures below 15 C inhibited growth. Bacterial isolates fell into two groups as regards temperature optima, the one having an optimum of 23 C and the other 30 C. The bacterial population in the Bot River estuary is clearly adapted to estuarine conditions. The estuary, being normally closed to the seas and being well-mixed due to wind turbulence, provides a relatively constant environment for bacteria. These bacteria are necessarily salt-tolerant and salt-requiring and none of the isolates appears to be of fresh-water origin. (See also W89-00649) (Author's abstract)
W89-00657

ANNUAL CYCLE OF FREE-FLOATING BACTERIA IN THE BOT RIVER ESTUARY,
Cape Town Univ. (South Africa). Dept. of Zoology.
C. H. Roberts, G. M. Branch, and F. T. Robb.
Transactions of the Royal Society of South Africa, Vol. 45, Parts 3 and 4, p 353-361, July 1985. 3 fig, 1 tab, 17 ref.

Descriptors: *Estuaries, *Estuarine environment, *Population dynamics, *South Africa, *Bot River Estuary, *Aquatic populations, *Seasonal variations, *Bacteria, Lagoons, Biomass, Water temperature, Salinity, Dissolved organic matter, Breaching, Sampling.

The Bot River estuary (South Africa) is normally closed to the sea and its bacterial population fluctuates seasonally, peaking in late summer. Parameters such as temperature, salinity, organic nutrients and turbidity may directly or indirectly cause these fluctuations. This study compared the spatial and temporal patterns of bacterial numbers and biomass in the Bot River estuary, which is normally closed, with the distribution of bacteria in previously studied open estuaries. The impact of artificially opening the mouth of the estuary was recorded. The seasonal bacterial distribution was determined from samples taken every two months at four sites. Bacterial numbers ranged between 1 times 10 to the sixth power and 3 times 10 to the sixth power. The spatial distribution of this bacterial population was found to differ from that of open estuaries studied elsewhere. However, artificial opening of the estuary results in a distribution pattern similar to that of open estuaries. (See also W89-00649) (Friedmann-PTT)
W89-00658

ZOOPLANKTON AND SOME ENVIRONMENTAL CONDITIONS IN THE BOT RIVER ESTUARY,
Department of Nature and Environmental Conservation, Stellenbosch (South Africa). Jonkershoek Nature Conservation Station.
D. J. Coetzee.
Transactions of the Royal Society of South Africa, Vol. 45, Parts 3 and 4, p 363-377, July 1985. 3 fig, 3 tab, 23 ref.

Descriptors: *Estuaries, *Estuarine environments, *Zooplankton, *Bot River Estuary, *Population dynamics, *South Africa, *Biomass, *Salinity, Aquatic populations, Seasonal variation, Physiological ecology, Lagoons.

A zooplankton study started during July 1980 while the Bot River estuary was closed off from the sea, and had a mean surface salinity of 13.5 ppt. The latter declined to 2.3 ppt in September 1981 before the estuary was opened to the sea at the Sonesta Holiday Resort, after which it increased again to means of, respectively, 28.9 and 30.8 ppt during November and December 1981, the last two months of the survey. Zooplankton numbers and biomass fluctuated seasonally with maximum mean values occurring during the spring of 1980. Apparently the estuarine zooplankton population in the Bot River estuary was adversely affected in terms of both numbers and biomass by the decrease in salinity prior to the opening of the estuary at Sonesta. Zooplankton composition, however, changed relatively little. The nauplii, copepodites and adults of the calanoid copepod Pseudodiaptomus hessei dominated numerically, together forming an average of approximately 90% of the zooplankton during the study. Only two marine zooplankton organisms, Oithona similis and Paracalanus crassirostris, were collected in the estuary, appearing after it was opened at Sonesta. The prevailing salinities in the estuary prior to its opening at Sonesta appear to have inhibited the breeding of an important estuarine bait organism, the sandprawn Callianassa kraussi. (See also W89-00649) (Author's abstract)
W89-00659

BENTHIC MACROFAUNA OF THE BOT RIVER ESTUARY, SOUTH AFRICA, WITH A NOTE ON ITS MEIOFAUNA,
Cape Town Univ. (South Africa). Dept. of Zoology.
H. P. De Decker, and R. Bally.
Transactions of the Royal Society of South Africa, Vol. 45, Parts 3 and 4, p 379-396, July 1985. 9 fig, 4 tab, 28 ref.

Descriptors: *Estuaries, *Estuarine environments, *Benthic fauna, *Biomass, *Bot River Estuary, *Population dyanamics, *South Africa, Aquatic populations, Lake sediments, Amphipods, Isopods, Polychaetes, Midges, Mollusks, Oligochaetes, Ditchgrass, Estuarine sediments, Species diversity.

The species composition, abundance, biomass and distribution of the benthic macrofauna of the Bot River estuary are discussed. In general, the fauna is impoverished, comprising mainly amphipods, isopods, polychaetes and mollusks. Average total biomass figures are 8.29 g dry mass/sq m for December 1982 and 4.32 g dry mass/sq m for May 1983. The tanaid, Apseudes digitalis, was the most abundant species, while the bivalve, Arcuatula capensis, had the highest biomass. Low diversities and abundances are attributed to the lack of contact with the sea. The estuary can be divided roughly into four major zones, based on the distribution and abundance of the benthic macrofauna. Faunistically, the zones differ with respect to the characteristic and numerically dominant species. Highest total biomass figures (91.63 g dry mass/sq m) are associated with the Ruppia beds, whereas the lowest figures were usually found in the deeper areas. The meiofauna of the system is noticeably impoverished, in terms of both numbers and diversity. The main groups represented are the platyhelminths, nematodes and oligochaetes, with a few chironomids, polychaetes and juvenile forms of macrofaunal amphipods. Densities are low (0.02 - 1.82 cu cm sediment) and the animals are relatively large for meiofaunal organisms. The abundance and diversity of these groups are closely related to the composition of the sediment, with the richest sediments being those with the lowest mud fractions, close to the sea. (See also W89-00649) (Author's abstract)
W89-00660

VARIATIONS IN THE USE OF THE BOT RIVER ESTUARY BY WATER-BIRDS,
Department of Nature and Environmental Conservation, Stellenbosch (South Africa).
C. W. Heyl, and M. H. Currie.
Transactions of the Royal Society of South Africa, Vol. 45, Parts 3 and 4, p 397-417, July 1985. 5 fig, 1 tab, 41 ref.

Descriptors: *Estuaries, *Estuarine environments, *Water birds, *South Africa, *Bot River Estuary, *Wetlands, *Ecosystems, *Aquatic animals, Breaching, Waterfowl, Lagoons, Management planning, Wildlife management.

The Bot River estuary (South Africa) is an important wetland for various waterbirds, and is especially of value as a safe refuge during the dry season. Its use by birds, however, varied widely over the study period, and was largely related to changing hydrological conditions in the estuary. Indications are that artificial breaching of the sandbar in particular affects the bird community, and that favorable environmental conditions for most species develop only after prolonged periods of three or more years after breaching. It is recognized, however, that the establishment of periodic estuarine conditions by means of direct contact with the sea would be in the interest of the waterbirds. It is therefore proposed that a management strategy of infrequent artificial breaching be pursued. (See also W89-00649) (Author's abstract)
W89-00661

ECOLOGICAL ROLE OF THE RED-KNOBBED COOT, FULICA CRISTATA GMELIN, AT THE BOT RIVER ESTUARY, SOUTH AFRICA: A PRELIMINARY INVESTIGATION,
Cape Town Univ. (South Africa). Dept. of Zoology.
B. A. Stewart, and R. Bally.
Transactions of the Royal Society of South Africa, Vol. 45, Parts 3 and 4, p 419-426, July 1985. 1 fig, 1 tab, 28 ref.

Descriptors: *Estuaries, *Estuarine environments, *Water birds, *Waterfowl, *Bot River Estuary, *South Africa, *Macrophytes, *Ecosystems, *Ecology, *Metabolism, Food chains, Productivity, Lagoons, Sago pondweed, Submerged, Ditch grass, Energetics, Cycling nutrients, Guano.

The red-knobbed coot Fulica cristata constitutes over 90% of the waterfowl numbers at the Bot River estuary, South Africa. To determine the impact of the birds on the submerged aquatic macrophytes at the estuary, aspects of the bioenergetics of the red-knobbed coot were studies. Captive birds of mean mass 720.4 g had a daily metabolized energy of 516 kJ per bird. The daily energy expenditure of the coots in the wild was estimated to be 691 kJ per bird. The birds assimilated 57.9% of their gross energy intake when feeding on Ruppia maritima L. and Potamogeton pectinatus L. and consumed approximately 82.4 g dry weight of macrophyte per bird per day during free existence. On the basis of their energy requirements, it is estimated that the coot population on the Bot River estuary consumed 759.5 tons dry weight, approximately 9.9-12.5% of the submerged macrophyte production in 1980-1981. Guano released into the water during the same period is estimated at 470.1 tons dry weight. (See also W89-00649) (Author's abstract)
W89-00662

COMPARISON OF THE PHYSIOLOGICAL CONDITION OF THE SOUTHERN MULLET LIZA RICHARDSONI (SMITH), IN A CLOSED ESTUARY AND THE SEA,
Cape Town Univ. (South Africa). Dept. of Zoology.
H. P. De Decker, and B. A. Bennett.
Transactions of the Royal Society of South Africa, Vol. 45, Parts 3 and 4, p 427-436, July 1985. 4 fig, 1 tab, 27 ref.

Descriptors: *Estuaries, *Estuarine environments, *Fish populations, *Fish physiology, *Bot River Estuary, *Mullet, *South Africa, *Aquatic populations, Fish behavior, Spawning, Tissue analysis, Comparison studies, Energetics, False Bay.

The physiological condition of the mullet, Liza richardsoni (Smith), from the closed Bot River estuary, is compared with that of the same species from False Bay. Levels of protein, lipid, water and ash, as well as energy content, were determined in fish from the two environments. Protein (17.94% vs. 18.53%) and ash levels (3.41% vs. 4.81%) were similar in both estuarine and marine fish. Lipid (9.95% vs. 2.23%) and energy levels (18.35 kJ/g dry weight vs. 14.18 kJ/g dry weight), were significantly higher, while levels of water (67.73% vs. 74.87%) were lower in the estuarine fish. On average, the estuarine L. richardsoni were in better condition than their marine conspecifics. Liza richardsoni does not spawn in estuaries and their better condition in the estuary could possibly be attributed to the retention of energy usually lost through spawning in the sea. On the other hand, estuarine subadults were already in an improved condition, which could only be due to better feeding conditions. It is therefore concluded that estuarine L. richardsoni can maintain a better condition due to both more favorable feeding conditions and the retention of energy usually lost through spawning. (See also W89-00649) (Author's abstract)
W89-00663

MASS MORTALITY OF FISH ASSOCIATED WITH LOW SALINITY CONDITIONS IN THE BOT RIVER ESTUARY,
Cape Town Univ. (South Africa). Dept. of Zoology.
B. A. Bennett.
Transactions of the Royal Society of South Africa, Vol. 45, Parts 3 and 4, p 437-447, July 1985. 2 fig, 2 tab, 21 ref.

Descriptors: *Estuaries, *Estuarine environments, *Fish populations, *South Africa, *Bot River Estuary, *Mortality, *Salinity, Population dynamics, Lagoons, Breaching, Population exposure, Lagoons, Monitoring, Dunes.

The Bot River estuary remains closed for prolonged periods during which the salinities decline progressively. In October 1981, after four years of isolation from the sea, the maximum salinity in the estuary fell to 3 ppt, resulting in a mass fish mortality. The extent of this is compared with the species composition and relative abundance of fish prior to the mortality and with published records of the minimum salinities that these species were previously known to tolerate. On the basis of this study, it is suggested that the salinity of the lagoon be regularly monitored and when the maximum falls to 4 ppt, the dune barrier should be artificially breached. (See also W89-00649) (Author's abstract)
W89-00664

CHANGES IN THE FISH FAUNA OF THE BOT RIVER ESTUARY IN RELATION TO OPENING AND CLOSURE OF THE ESTUARY MOUTH,
Cape Town Univ. (South Africa). Dept. of Zoology.
B. A. Bennett, K. C. D. Hamman, G. M. Branch, and S. C. Thorne.
Transactions of the Royal Society of South Africa, Vol. 45, Parts 3 and 4, p 449-464, July 1985. 6 fig, 2 tab, 24 ref.

Descriptors: *Estuaries, *Estuarine environments, *Fish populations, *Bot River Estuary, *Population dynamics, *South Africa, *Fish management, *Breaching, Ecosystems, Lagoons, Kleinmond Estuary.

The fish community of the Bot River estuary (South Africa) was sampled with seine and gill nets between April 1980 and July 1983. During part of this period, the estuary, which is usually closed, was in contact with the sea via an artificially opened deep-water mouth as well as the natural spill way into the adjacent Kleinmond estuary. Changes in the species composition, abundance, and size-structure of the fish community are described that occurred as a result of these connections with the sea, as well as seasonal and longer-term changes that occurred during the closed phase. The implications of opening the mouth, for the fish and the fishermen that utilize the lagoon, are outlined, and management options are discussed. The responses of the different species to direct opening of the estuary at Sonesta depended largely on their life cycles. With two exceptions, species that breed in the estuary did not emigrate when it was open. This finding lends support to earlier published conclusions that these species are entirely dependent on estuaries throughout their life cycles. The abundance and size-structure of those species that breed only in the seas showed a common pattern. Typically, only large individuals of these species were present before the estuary was opened. After opening, catches of the large fish declined while small fish suddenly appeared, often in large numbers. It is clear from fish size-structure and abundance cycles that periodic breaching of the dune barrier is essential for these species to remain available to fishermen in the estuary. Also, some of the fish species in the estuary may be entirely dependent on estuaries as juveniles. The Bot River estuary thus may play a significant role in maintaining stocks of these species. (See also W89-00649) (Friedmann-PTT)
W89-00665

SYNOPSIS OF THE IMPACT OF ARTIFICIALLY OPENING THE MOUTH OF THE BOT RIVER ESTUARY: IMPLICATIONS FOR MANAGEMENT,
Cape Town Univ. (South Africa). Dept. of Zoology.
G. M. Branch, R. Bally, B. A. Bennett, H. P. De Decker, and G. A. W. Fromme.
Transactions of the Royal Society of South Africa, Vol. 45, Parts 3 and 4, p 465-483, July 1985. 5 fig, 1 tab, 39 ref.

Descriptors: *Estuaries, *Estuarine environment, *Geomorphology, *Bot River Estuary, *Breaching, *Sedimentology, *Aquatic populations, *Ecology, *Population dynamics, Ecosystems, Waterfowl, South Africa, Salinity, Saline water, Long-term planning, Management planning, Kleinmond Estuary, Lakes, Flushing, Environmental management.

Previous research on the Bot River estuary is synthesized, including that on its past and present geology, sedimentology, hydrology, history, plant life, invertebrates, birds and fish. The estuary is periodically breached to form a deep mouth and this restores estuarine conditions and allows recruitment of fish; but it also disrupts the system and results in massive losses of aquatic weeds and invertebrates, and a twentyfold reduction in bird life. A key feature in the ecology is that the Bot is connected to the adjacent Kleinmond estuary by overflow channels that act as a spillway when water levels in the Bot are high. Because of this, the Bot will slowly become diluted by river water and change into a freshwater lake if it is not breached. Six proposed plans for the management of the Bot River estuary are discussed. Only two are viable: either the estuary should never be breached (and thus be managed as a freshwater lake) or breaching should be controlled and undertaken about every three or four years or when salinities drop below 6 ppt (and the system managed as an estuary). (See also W89-00649) (Author's abstract)
W89-00666

EXPERIMENTAL DETERMINATION OF SALT INTRUSION MECHANISMS IN THE VOLKERAK ESTUARY,
Rijkswaterstaat-Deltadienst, The Hague (Netherlands).
J. Dronkers, and J. VanDeKreeke.
Netherlands Journal of Sea Research NJSRBA, Vol. 20, No. 1, p 1-19, June 1986. 20 fig, 1 tab, 14 ref.

Descriptors: *Saline water intrusion, *Volkerak Estuary, *Estuaries, *The Netherlands, *Water circulation, Seawater, Fluctuation, Water currents, Tidal effects.

Salt transport mechanisms in the Volkerak estuary, The Netherlands, were analyzed using the results of simultaneous measurements of current and salt concentrations in 32 verticals distributed over six cross-sections. Longitudinal salt fluxes in each cross-section were evaluated by interpolating measured values of current speed and salt concentration over the cross-section and in time. The field data and subsequent analysis reveal that in the seaward part of the estuary the advective salt flux is balanced by the non-local dispersive flux. Salt intrusion in this region is caused by large scale exchanges of water bodies between the Volkerak estuary and Eastern Scheldt estuary, between different tidal channels at channel junctions and between tidal channels and tidal flats. In the landward part of the estuary gravitational circulation is the dominant salt intrusion process, reflected most strongly in the local salt flux component associated with steady vertical variations in velocity and salt concentrations. (Author's abstract)
W89-00667

COMPARISON OF METHODS FOR THE DETERMINATION OF CHLOROPHYLL IN ESTUARINE SEDIMENTS,
Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
E. A. M. J. Daemen.
Netherlands Journal of Sea Research NJSRBA, Vol. 20, No. 1, p 21-28, June 1986. 2 fig, 5 tab, 20 ref.

Descriptors: *Estuaries, *Sediment, *Pigments, *Plant pigments, *Chemical analysis, *Chlorophyll, Chlorophyll a, Comparison studies, Chromatography, Spectrophotometry, Fluorometry, Estuarine environment, Oosterschelde estuary.

Five methods for the determination of the chlorophyll content in solutions of pure chlorophyll and pigment extracts of estuarine sediments were compared using samples from the Oosterschelde estuary. If only chlorophyll a was present, spectrophotometric, fluorometric, as well as HPLC methods yielded reliable results. In samples containing a mixture of pigments, the spectrophotometric method appears to be preferable to the fluorometric determination, unless the relation between spectrophotometer and fluorometer readings is checked regularly. However, in pigment extracts that contain a mixture of pigments, the most reliable results will be obtained with the HPLC tech-

nique because interference by the various pigments in the extract is excluded as they are separated before quantification. Similar results are reported from the literature for phytoplankton. The conclusions drawn from the analysis of samples from the water column are thus also valid for sediments containing chlorophyll in addition to large amounts of organic matter. (Author's abstract)
W89-00668

CA(+2)-STRESS, BIOLOGICAL RESPONSE AND PARTICLE AGGREGATION IN THE AQUATIC HABITAT,
Hamburg Univ. (Germany, F.R.). Geologisch-Palaeontologisches Inst. und Museum.
For primary bibliographic entry see Field 2K.
W89-00669

TIDAL ASYMMETRY AND ESTUARINE MORPHOLOGY,
Rijkswaterstaat, The Hague (Netherlands). Div. of Tidal Waters.
J. Dronkers.
Netherlands Journal of Sea Research NJSRBA, Vol. 20, No. 2/3, p 117-131, August 1986. 10 fig, 56 ref, append.

Descriptors: *Estuaries, *Channel morphology, *Geomorphology, *Tidal effects, *Sediment transport, Tidal currents, Water currents, Tidal asymmetry.

The relationship between tidal asymmetry and estuarine morphology is investigated. The present study was concerned mainly with the evolution of the estuary by the long-term averaged sediment supply from inland or coastal origin, and the direction and magnitude of the long-term averaged sediment transport. Tidal wave deformation in shallow systems with a regular or a complex geometry and subsequent impact on the residual sediment flux was also analyzed. There is a differene between the slack water periods before ebb and flood which affects in particular the residual transport of the fine fraction of the suspended load. In regularly shaped basins and in the absence of river inflow, the tidal wave tends to be distorted. This distortion is seen in the inner part of both long and short tidal basins and will cause a sediment infill of estuaries in periods of small river discharge. In irregularly shaped estuaries, the tidal current variation is influenced by the geometry which may favor a residual import of fine sediment in some cases and inhibit it in others. Coastal shelf and wind effects also play a role in shaping estuaries. (Miller-PTT)
W89-00670

FLOCCULATION AND DE-FLOCCULATION OF SUSPENDED MATTER IN ESTUARIES,
Nederlands Inst. voor Onderzoek der Zee, Texel.
D. Eisma.
Netherlands Journal of Sea Research NJSRBA, Vol. 20, No. 2/3, p 183-199, August 1986. 13 fig, 1 tab, 77 ref.

Descriptors: *Estuaries, *Suspended solids, *Flocculation, *Organic compounds, Chemical properties.

Flocculation and de-flocculation have been observed in estuaries and the processes involved are discussed. An attempt is made to put these observations into a larger framework of suspended particle behavior in estuaries and coastal seas. For the study of in situ suspended matter in estuaries, two methods were applied: (1) direct photography in the water, and (2) sampling by divers with a special device aimed at collecting undisturbed samples. In situ photography was carried out with a Benthos plankton camera. Suspended matter in estuaries and the lower reaches of rivers is presented as microflocs and mineral particles of up to 125 micrometers diameter flocculated into macroflocs of up to 3-4 mm diameter. The microflocs consist of strongly bound mineral particles glued together by organic matter. The macroflocs are loosely bound and fragile, easily broken up by the physical disturbance during sampling and size analysis but stable in flowing water at current speeds of up to 1.5 m/s. Macroflocs are predominantly formed under conditions of viscous flow and glued together by organic matter. Mucopolysaccharides, produced by bacteria, algae and higher plants and mobilized from the suspended matter at low salinity, are important in glueing the particles together. In estuaries the microflocs of fluvial origin are broken up by organisms consuming the organic matter in the microflocs and reflocculated into new microflocs with newly formed organic material of estuarine origin. (Miller-PTT)
W89-00671

PARTITIONING OF ORGANOCHLORINES BETWEEN WATER, PARTICULATE MATTER AND SOME ORGANISMS IN ESTUARINE AND MARINE SYSTEMS OF THE NETHERLANDS,
Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
For primary bibliographic entry see Field 5B.
W89-00672

DYNAMICS OF DISSOLVED SILICIUM AND NITROGEN-NUTRIENTS AT LOW TEMPERATURE IN THE EMS-DOLLARD ESTUARY,
Nederlands Inst. voor Onderzoek der Zee, Texel.
W. Helder, and R. T. P. DeVries.
Netherlands Journal of Sea Research NJSRBA, Vol. 20, No. 2/3, p 277-284, August 1986. 7 fig, 1 tab, 37 ref.

Descriptors: *Nitrogen cycle, *Nutrients, *Temperature effects, *Sediment-water interfaces, *Estuaries, Silicates, Ammonia, Nitrates, Ems River, Westerwoldse River, Fluorescence, Nitrification, Salinity, Chemical properties, Ems-Dollard Estuary.

Results are presented from a winter situation (4-6 C, January 1975) when concentration changes of ammonia and nitrate can be attributed completely to nitrification in the water passing through the Ems-Dollard estuary on the German-Dutch border. Using salinity and fluorescence as conservative tracers to discriminate between fresh water contributions from two different fresh water sources (the river Ems and the river Westerwoldse Aa), deviations from conservative behavior for silicate, ammonia and nitrate are reported. For silicate, a net removal from overlying water during transport through the estuary of 15% was found. Nitrification in overlying water was the only important process in nitrogen cycling. Sediment-water exchange was of no importance during this period. (Miller-PTT)
W89-00673

INCREASED PHYTOPLANKTON PRIMARY PRODUCTION IN THE MARSDIEP AREA (WESTERN DUTCH WADDEN SEA),
Nederlands Inst. voor Onderzoek der Zee, Texel.
For primary bibliographic entry see Field 5C.
W89-00674

ADVENTURES IN HOLISTIC ECOSYSTEM MODELLING: THE CUMBERLAND BASIN ECOSYSTEM MODEL,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Marine Ecology Lab.
D. C. Gordon, P. D. Keizer, G. R. Daborn, P. Schwinghamer, and W. L. Silvert.
Netherlands Journal of Sea Research NJSRBA, Vol. 20, No. 2/3, p 325-335, August 1986. 7 fig, 1 tab, 20 ref.

Descriptors: *Model studies, *Cumberland Basin, *Bay of Fundy, *Canada, *Estuaries, Environmental policy, Basins, Benthos, Physical properties.

A holistic ecosystem model has been developed for the Cumberland Basin, a turbid macrotidal estuary at the head of Canada's Bay of Fundy. The model was constructed as a group exercise involving several dozen scientists. Philosophy of approach and methods were patterned after the BOEDE Ems-Dollard modelling project. The model is one-dimensional, has 3 compartments and 3 boundaries, and is composed of 3 separate submodels (physical, pelagic and benthic) The 28 biological state variables cover the complete estuarine ecosystem and represent broad functional groups of organisms based on trophic relationships. Although still under development and not yet validated, the model has been verified and has reached the stage where most state variables provide reasonable output. The modelling process has stimulated interdisciplinary discussion, identified important data gaps and produced a quantitative tool which can be used to examine ecological hypotheses and determine critical environmental processes. As a result, Canadian scientists have a much better understanding of the Cumberland Basin ecosystem and are better able to provide competent advice on environmental management. (Author's abstract)
W89-00675

EFFECTS ON THE BENTHIC FAUNA OF EMBANKING AN INTERTIDAL FLAT AREA (THE MARKIEZAAT, EASTERN SCHELDT ESTUARY, THE NETHERLANDS),
Nederlands Inst. voor Onderzoek der Zee, Texel.
For primary bibliographic entry see Field 6G.
W89-00676

DYNAMICAL STRUCTURE OF VERTICALLY TWO-DIMENSIONAL ESTUARY IN STEADY STATE,
Kyoto Univ. (Japan). Geophysical Inst.
M. Murakami.
Journal of the Oceanographical Society of Japan NKGKB4, Vol. 42, No. 3, p 224-239, June 1986. 6 fig, 4 tab, 16 ref. Ministry of Education, 1981 Science and Culture Grant 56030031.

Descriptors: *Estuaries, *Salinity, *Eddy diffusion, *Model studies, *Viscosity coefficient, *Advection, Mathematical models, Dynamics, Velocity.

The dynamical structure of a two-dimensional (depth and axial directions) estuary studied analytically. A set of governing equations describing the time-averaged velocity and salinity in the estuary used, where all of the external parameters (depth, width, freshwater discharge, and horizontal and vertical coefficients of eddy viscosity and eddy diffusivity) are assumed to be constant along the estuary. Two dynamical relations are taken into consideration in the theory: (1) the dependence of the longitudinal scale, L sub d, depends on the balance of longitudinal salt transport, and (2) the relation between the vertical stratification of salinity and the Prandtl number. The two relations result in an extension of the parameter range in which the linear balance of momentum holds. A linear state of motion (LM-state) is defined as the state where the momentum balance is linear. The LM-state comprises the so-called vertically homogeneous and the so-called partially mixed state. Perturbation analysis is introduced and dynamical theory is developed in the LM-state. Since the LM-state covers a fairly wide regime with respect to the balance of salt transport, the state is subdivided into three stages: the diffusive, intermediate, and advective stages. In the diffusive stage, the upstream transport is mainly attributed to the horizontal diffusion, whereas in the advective stage it is attributed to advection caused by gravitational circulation. The salinity balance is also linear in the diffusive and intermediate stages, whereas the balance is nonlinear in the advective stage. The advective stage of the LM-state is regarded as a stage bordering the salt wedge state. The longitudinal distribution of depth-mean salinity was found to take an exponential form in the diffusive stage, a nearly linear form in the advective stage and an intermediate form in the intermediate stage. (Author's abstract)
W89-00680

DIURNAL CHANGES OF PH DISTRIBUTION AND THE CASCADING OF SHORE WATER IN A SARGASSUM FOREST,
Kyoto Univ. (Japan). Dept. of Fisheries.
T. Komatsu, and H. Kawai.
Journal of the Oceanographical Society of Japan NKGKB4, Vol. 42, No. 6, p 447-459, December 1987. 10 fig, 1 tab, 11 ref.

Descriptors: *Hydrogen ion concentration, *Coastal waters, *Spatial distribution, *Algae, *Stratification, *Seasonal variation, *Diurnal distribution, Algal growth.

The influence of a Sargassum forest on the pH distribution in a small cove facing Wakasa Bay (Japan) was examined. The diurnal changes in spatial distribution of density and pH were observed in May 1977 during the season of luxuriant seaweed growth, and in August 1977 during the season of little growth. The observations were made at three-hour intervals for 24 hours in May and 9 hours in August. During the period of strong density stratification, the observed pH distributions were divided into two types: (1) lower pH inshore and higher offshore in the evening and early morning, and (2) higher pH inshore and lower offshore in the daytime. During the period of weak density stratification, a homogeneous pH distribution was observed. The pH distribution influenced by Sargassum forest during the season of luxuriant growth was different from that during the season of little growth and the process that caused these spatial distributions is discussed. From early dawn to forenoon during the season of luxuriant growth, the heavier water produced inshore by cooling through nocturnal radiation cascaded as a stable laminar flow under canopies of the forest and detached floating seaweeds. Reaching the offshore lower layer and co-acting with algal respiration, this cascade influenced pH distribution. Some dynamical parameters for the process of cascading were calculated and examined. By analyzing the diurnal changes of spatial distributions of density and pH, it has been found that the Sargassum forest influences various environmental factors which, in turn, influence each other. (Author's abstract)
W89-00682

ESTIMATING BACTERIAL PRODUCTION IN MARINE WATERS FROM THE SIMULTANEOUS INCORPORATION OF THYMIDINE AND LEUCINE,
Delaware Univ., Lewes. Coll. of Marine Studies.
For primary bibliographic entry see Field 7B.
W89-00729

RELATIONSHIP BETWEEN NITROGEN-FIXING SULFATE REDUCERS AND FERMENTERS IN SALT MARSH SEDIMENTS AND ROOTS OF SPARTINA ALTERNIFLORA,
South Carolina Univ., Columbia. Dept. of Biology.
E. L. Gandy, and D. C. Yoch.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 8, p 2031-2036, August 1988. 5 fig, 1 tab, 38 ref. PHS Grant 2-RO1 GM32183 from the National Institute of General Medical Studies.

Descriptors: *Salt marshes, *Nitrogen fixation, *Sulfates, *Sediments, *Roots, *Spartina, Substrates, Sulfur bacteria, Acetylene reduction, Inhibitors, Molybdenum, Glucose, Plant tissues, Fermentation, Oxidation.

A combination of inhibitors and carbon substrates was used to determine the relative contribution of sulfate-reducing bacteria (SRB) and fermenting bacteria to nitrogen fixation in a salt-marsh sediment and on the roots of Spartina alterniflora. Because a lag period precedes acetylene-reducing activity (ARA) in amended sediments, an extensive analysis was done to be sure that this activity was due to the activation of dormant cells, not simply to cell proliferation. Since ARA was not affected by metabolic inhibitors such as rifampin, nalidixic acid, or methionine sulfoximine, it appeared that cell growth was not responsible for this activity. Instead, dormant cells were being activated by the added energy source. Molybdate inhibition studies with glucose-amended sediment slurries indicated that ARA in the upper 5 cm of the salt marsh was due primarily (70%) to SRB and that below that level (5 to 10 cm) it was due primarily (>90%) to fermenting bacteria. ARA associated with washed roots of intact S. alterniflora plants was not inhibited by molybdate, which indicates that bacteria other than SRB were responsible. However, when the roots were excised from the plant, the activity (per unit of root mass) was 10-fold higher and was severely inhibited by molybdate. While this high activity is probably an artifact, due to the release of oxidizable substrates from the excised roots, it indicates that SRB are present in high numbers on Spartina roots. (Author's abstract)
W89-00732

MICROBIAL-MEIOFAUNAL INTERRELATIONSHIPS IN SOME TROPICAL INTERTIDAL SEDIMENTS,
Australian Inst. of Marine Sciences, Townsville.
D. M. Alongi.
Journal of Marine Research JMMRAO, Vol. 46, No. 2, p 349-365, May 1988. 7 fig, 1 tab, 38 ref. MST Grant No. 86/0708.

Descriptors: *Ecosystems, *Tropical regions, *Marine animals, *Intertidal areas, *Microorganisms, *Marine sediments, Sand bars, Aquatic environment, Aquatic animals, Tidal flats, Productivity, Australia, Biomass, Bacteria, Growth rate, Benthic fauna, Protozoa, Tides.

Interrelationships among microbial and meiofaunal communities were examined for one year at four intertidal mangrove and sandflat habitats in tropical northeastern Australia. None of the microbial and meiofaunal communities correlated with physical factors over the year as densities of most microbial and meiofaunal groups, bacterial productivity and specific growth rates of bacteria fluctuated significantly over time at each habitat with no distinct seasonality. However, over a tidal cycle, bacterial growth rates were significantly affected by tidal flooding and exposure on the sandflat; bacterial growth rates increased with increasing sediment temperatures upon exposure during daylight. Protozoan and meiofaunal abundance generally did not change significantly over tidal cycles. There were few significant correlations and no time lags of bacterial growth rates, and bacterial and microalgal (as chlorophyll a) densities with protozoans and meiobenthos (including nematode species and trophic groups) over the year or during tidal cycles. In concert with the very high rates of bacterial productivity (x-bar = 475 mgC/sq m/d; range, 45-1725 mgC/l/sq m/d) measured in these tropical sediments, the results suggest that protozoan and meiofaunal communities may not be tightly coupled to the dynamics of bacterial and microalgal communities in some tropical intertidal habitats. (Author's abstract)
W89-00766

STUDIES ON FORMATIONS AND CHANGES OF MICRO-STRATIFICATION IN BLACKISH WATER LAKE SHINJI, (IN JAPANESE),
Chugoku Regional Construction Bureau Officials Relief Association, Enya (Japan).
For primary bibliographic entry see Field 2H.
W89-00772

COASTAL TOPOGRAPHY OF THE MORAY FIRTH,
Aberdeen Univ. (Scotland). Dept. of Geography.
J. S. Smith.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 91, p 1-12, 1986. 3 fig, 12 ref.

Descriptors: *Moray Firth, *Geology, *Glaciation, *Coastal waters, *Erosion, *Beaches, *Scotland, Longshore drift, Sediments, Estuaries, Rivers.

The geology, glaciation, deglaciation and sea level history are summarized in relation to the evolution of the coastline between Duncansby and Kinnairds Head, Scotland. Deglaciation and sea level are established as particularly important factors responsible for the distribution of sand and shingle beach forelands. Forelands in the middle coastline of the southern shore of the firth are currently undergoing relatively severe coastal erosion. It is argued that this results from a diminution of nearshore sediment supplies combined with a unidirectional longshore movement of material along the beach face. (See W89-00776 thru W89-0073) (Author's abstract)
W89-00775

NATURE CONSERVATION IN THE MORAY FIRTH,
Nature Conservancy Council, Edinburgh (Scotland).
P. J. Tilbrook.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 91, p 13-25, 1986. 3 fig, 7 ref.

Descriptors: *Scotland, *Moray Firth, *Coastal waters, *Conservation, *Natural resources, *Regional development, Estuaries, Urbanization, Rivers, Regional planning, Legislation.

The nature conservation interest and value of many sites in the Moray Firth (Scotland) are described in their international, national and local contexts. Man-induced pressures on the natural environment identified and discussed result from settlements, communications, industry, fisheries, agriculture, forestry, military use, and recreation. The roles of local and national agencies and legislation are considered in relation to future strategies for nature conservation within the Moray Firth. (See also W89-00775) (Author's abstract)
W89-00776

COASTAL PLANNING IN THE MORAY FIRTH,
R. G. H. Turnbull.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 91, p 27-35, 1986. 2 tab, 6 ref.

Descriptors: *Moray Firth, *Coastal waters, *Management planning, *Water resources development, *Regional development, *Scotland, Oil industry, Data collections, Estuaries, Rivers.

Since the late 1940s coastal planning in the Moray Firth (Scotland), as elsewhere in Britain, has been carried out by appropriate planning authorities within the framework of the statutory development planning and development control system. In the formulation of plans and policies for the coast, regional district authorities have responded to national policy guidelines and to the advice received from statutory organizations and others. Controversy and differences have been dealt with by consultation and by local public inquiries. In safeguarding the coastline, particularly in the inner Moray Firth, planning authorities have had environmental management responsibility for oil and gas-related activities, recreational and tourist facilities, pollution protection and beach erosion. Continuing pressures and uncertainties about future prospects for oil and gas developments have also generated an unusual amount of administrative, survey and research activity at national, regional and district levels. However, the expertise and knowledge gained provide a unique and valuable information base upon which to prepare an overall coastal strategy. (See also W89-00775) (Author's abstract)
W89-00777

HYDROGRAPHY AND PLANKTON OF THE MORAY FIRTH,
Marine Lab., Aberdeen (Scotland).
J. A. Adams, and J. H. A. Martin.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 91, p 37-56, 1986. 17 fig, 19 ref.

Descriptors: *Hydrography, *Moray Firth, *Coastal waters, *Phytoplankton, *Zooplankton, *Scotland, Mixing, Saline-freshwater interfaces, Wind-driven currents, Density stratification, Seasonal variation, Water currents, Tidal effects, Biomass, Estuaries, Rivers.

The Moray Firth (Scotland) forms part of the north British coastal area of the North Sea and is distinguished by its depth, hydrography and plankton from the offshore northern North Sea. The isohaline can be taken as the boundary between the two areas. Geographical and seasonal variations in temperature and salinity are described in terms of a belt of low salinity coastal water in the inner firth and along its southern shore and of 'mixed' water to the north and east. During the winter the 'mixed' water is warmer than the coastal water, during the summer it is colder. Tidal streams are

dominantly semi-diurnal, relatively weak in the inner firth and relatively strong in the outer firth. Residual currents are largely wind driven, and some are caused by tidal effects. Geographical variation in the seasonal changes in the phytoplankton standing stock is related to water column stratification. The early spring standing stocks are highest in the inner firth and off the southern shore. During the summer and early autumn, phytoplankton is most abundant below the pycnocline. Average zooplankton standing stocks increase from 0.2, 0.6 g dry weight/100 cu m winter to 1.0 g/100 cu m exceptionally 4.5 g/100 cu m, in summer. Standing stocks in November-December range from 0.3 to 1.8 g/100 cu m. (See also W89-00775) (Author's abstract)
W89-00778

EXPLOITED FISH AND SHELLFISH SPECIES IN THE MORAY FIRTH,
Marine Lab., Aberdeen (Scotland).
P. J. Hopkins.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 91, p 57-72, 1986. 14 fig, 29 ref.

Descriptors: *Scotland, *Regional development, *Moray Firth, *Fish hatcheries, *Coastal waters, *Species composition, *Population dynamics, Fish physiology, Reproduction, Estuaries, Rivers, Fish, Crustaceans, Bottom sediments, Ecology.

The Moray Firth (Scotland) has been intensively fished for many years and has been of great historic importance to the development of Scottish fisheries. The stocks of exploited species in the firth and their relations to other stocks in Scottish waters are described. Exploited demersal species include haddock, cod, whiting, plaice and lemon sole. The firth is an important nursery area for plaice, and is the most important plaice spawning ground in the North Sea. The Moray Firth is also an important nursery area for herring. Evidence suggests that these fish recruit to adult stocks in the Minch. In the early 1960s a pair trawl fishery for sprats started and the firth became the most important sprat fishing area in Scotland. However, recruitment of recent year classes has been too poor to sustain the fishery, which has now been closed in order to protect the juvenile herring which were landed as by-catch. The distributions of shellfish species are closely related to the bottom sediments. Landings have become increasingly important as the demersal and pelagic fisheries have declined or moved further offshore. The fishery on the Norway lobster is now of particular importance and the catch per unit effort data do not suggest any decline in stock size. Other exploited species include squid, scallops, crabs and lobster. (See also W89-00775) (Author's abstract)
W89-00779

INTERTIDAL MACROFAUNA OF NIGG BAY,
Aberdeen Univ. (Scotland). Dept. of Zoology.
D. Raffaelli, and P. R. Boyle.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 91, p 113-141, 1986. 32 fig, 3 tab, 8 ref.

Descriptors: *Nigg Bay, *Moray Firth, *Species composition, *Intertidal areas, *Scotland, *Population dynamics, *Coastal waters, Aquatic habitats, Aquatic animals, Biomass, Tidal effects, Spatial distribution, Estuaries, Surveys, Sediments.

Surveys of the intertidal macrofauna and sediment characters of Nigg Bay, Moray Firth (Scotland), were carried out between 1981 and 1985. Permanent stations were located at the intersections of a half-kilometer grid covering the entire intertidal area and sampled for infauna, using replicate cores. Estimates were also made of mussel and lugworm densities from quadrats and cast counts respectively. The biomasses of selected species that constitute important resources for higher trophic levels were also estimated. The sediment for each station was analyzed for median particle diameter and silt content. The infaunal data were analyzed by detrended correspondence analysis. This indicated that tidal height was the most important factor governing the distribution and abundance of the intertidal communities. Sediment characters were only poorly related to distribution patterns. The bay has a rich fauna and is biologically similar to other outer bays of the Moray Firth, which, like Nigg, are important areas for wildfowl and waders. Comparisons of survey data from different years indicate that there are natural cycles in some sediment and biological characters of Nigg Bay. (See also W89-00775) (Author's abstract)
W89-00780

MORAY FIRTH MARINE FOULING COMMUNITIES,
Aberdeen Univ. (Scotland). Dept. of Zoology.
G. B. Picken.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 91, p 213-220, 1986. 1 fig, 2 tab, 9 ref.

Descriptors: *Invertebrates, *Scotland, *Fouling, *Moray Firth, *Coastal waters, *Nigg Bay, Tidal effects, Aquatic habitats, Estuaries, Rivers, Beatrice field, Oil fields, Substrates.

Fouling communities typical of shallow water inshore sites were found at three locations in the Moray Firth. At each, an initial background cover of solitary tubeworms and barnacles was overgrown by secondary fouling organisms. On the piles of Nigg jetty, overgrowth consisted of mussels in the depth range 0.6 m and hydroids, sponges, soft corals and anemones from 6-26 m. Buoys in the approaches to Cromarty Firth were completely covered by a mixture of algae and mussels. Sunlit areas of the float cleaned annually bore a diverse algal cover, whereas uncleaned shaded areas and the freely hanging chain had three-year-old mussels up to 7 cm long. Mussel fouling extended down the chain to within 1 m of the seabed at 26 m depth. Concrete anchor blocks on the seabed were covered with solitary tubeworms and hydroids. Steel piled platforms in the Beatrice Field were completely fouled after four years. Mussels and seaweeds were abundant from 0-5 m. In the depth range 8-35 m the background calcareous layer was overgrown by soft corals up to 10 cm long and hydroids. From 35 m to the seabed at 46 m, soft overgrowth was provided mainly by hydroids and ascidians, with only a few small corals. (See also W89-00775). (Author's abstract)
W89-00781

MACROBENTHOS OF THE BEATRICE OILFIELD, MORAY FIRTH, SCOTLAND,
Field Studies Council, Pembroke (Wales). Oil Pollution Research Unit.
J. P. Hartley, and J. D. D. Bishop.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 91, p 221-245, 1986. 12 fig, 4 tab, 31 ref, append.

Descriptors: *Beatrice oilfield, *Moray Firth, *Baseline studies, *Benthos, *Macroinvertebrates, *Oil fields, *Scotland, Biogeography, Estuaries, Rivers, Coastal waters, Species composition, Population dynamics, Aquatic habitats.

The benthic ecology of the Beatrice Oilfield area is described from preproduction surveys carried out in 1977, 1980 and 1981, and from earlier published information. Variations in the water depth (from 33 m to > 60 m) over the area were mirrored by sedimentary and faunal gradients. The sediments ranged from very fine, through fine to medium sands and were inhabited by faunal communities characterized by Thyasira flexuosa, Tellina fabula and Tellina pygmaea, respectively. Two facies of the fine sand community were noted, typified by the abundance of Thyasira flexuosa in muddier sediments and Crenella decussata in coarser deposits. Localized patches of shell gravel in which the fauna was characterized by reduced densities of Tellina fabula with elevated numbers of Scoloplos armiger and Lumbrineris gracilis occurred in medium depths. Examination of the faunal composition indicates that the Beatrice Oilfield lies at the interface between Glemarec's infralittoral and coastal stages. Comparison with earlier reports of the benthic communities of the area suggests a degree of long term persistence of the fauna in qualitative and quantitative terms. A list of all taxa found during the recent surveys is given; this includes a number of new records from the North Sea. (See also W89-00775) (Author's abstract)
W89-00782

COMPARISON OF THE FAUNA RETAINED ON 0.5 MM AND 1.0 MM MESHES FROM BENTHIC SAMPLES TAKEN IN THE BEATRICE OILFIELD, MORAY FIRTH, SCOTLAND,
Field Studies Council, Pembroke (Wales). Oil Pollution Research Unit.
J. D. D. Bishop, and J. P. Hartley.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 91, p 247-262, 1986. 6 tab, 28 ref.

Descriptors: *Benthic fauna, *Oil fields, *Scotland, *Beatrice oilfield, *Moray Firth, *Coastal waters, Species composition, Population dynamics, Estuaries, Sampling, Species diversity, Statistics.

The identity and abundance of animals passing through a 1.0 mm mesh but retained on a 0.5 mm mesh is detailed for a number for seabed samples of medium, fine and very fine sand taken in the Beatrice Oilfield in 1981. Comparisons are made with the corresponding 1.0 mm-sieved fractions, and the effects on community parameters of combining the two data sets are considered. In general fewer animals were found on the 0.5 mm mesh than on the 1.0 mm mesh above it. The 0.5 mm mesh samples added comparatively few taxa to the faunal list of the survey. The quantitatively-scored taxa from the 0.5 mm mesh were therefore essentially a sub-set of those already recorded on the 1.0 mm mesh. Several taxa of Foraminiferida were found only on the 0.5 mm mesh, and one of these appeared to be relatively abundant. In all samples, when 0.5 mm and 1.0 mm data were combined an increase was noted in the number of taxa recorded compared with 1.0 mm data alone. This recruitment of taxa was largely a reflection of the greater number of individuals in the combined data, rather than the inclusion of taxa unique to the 0.5 mm material. Similarly, the improved precision of abundance estimates of dominant taxa in replicate samples in the combined data probably resulted from the greater number of individuals included in the analysis. It is argued that the choice of a particular mesh size imposes an essentially arbitrary cut-off along the size spectrum of benthic organisms. A 1.0 mm mesh has been found to yield adequate data in a number of offshore surveys undertaken by the Oil Pollution Research Unit (OPRU). Although a greater number of animals per sample is collected by sieving on a 0.5 mm mesh, the time taken to extract and identify this material must be considered. The alternative of spending an equivalent time analyzing extra 1.0 mm samples may in fact yield a greater increase in confidence in the results. (See also W89-00775) (Author's abstract)
W89-00783

SUB-LITTORAL FAUNA OF THE INVERNESS, CROMARTY AND DORNOCH FIRTHS,
Highland River Purification Board, Dingwall (Scotland).
J. Hunter, and D. Rendall.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 91, p 263-274, 1986. 5 fig, 5 ref, append.

Descriptors: *Moray Firth, *Benthic fauna, *Macroinvertebrates, *Coastal waters, *Scotland, *Population dynamics, Biomass, Aquatic habitats, Aquatic animals, Estuaries, Spatial distribution.

The sublittoral fauna at eight stations in the Beauly and Inverness Firths, six stations in the Cromarty Firth and eight sites in the Dornoch Firth have been sampled and identified. The three firths are part of the western side of the Moray Firth (Scotland). The fauna included annelids, crustaceans echinoderms, bryozoans, and a few representor's of other invertebrate groups. The degree of similarity between the faunas of the various stations was measured and the stations paired in order of decreasing similarity (Czekanowski coefficient with group-averaged sorting). The resulting dendro-

gram first groups the deep muddy stations of the Cromarty Firth. Then at a lower similarity the Inverness Alturlie station is added. All these stations have muddy bottoms and Abra-Nucula communities. Another group comprising the sandiest of the Cromarty Firth stations and the sandy stations from the Inverness Firth combines with the previous groups of stations at about the 40% similarity level. The sandy stations from the middle of the Dornoch Firth are grouped together with fairly high similarity. The Inverness Firth stations at Kessock and Meikle Mee are closely grouped due to their dominance by polynoid and other epifaunal species. The two Moray Firth stations at the seaward extremities of the Cromaryt and Dornoch transects come out with very little similarity to the stations within the firths and very little similarity to each other. There seems to be a fairly sharp discontinuity between the fauna within the firths and the fauna of the open Moray Firth. The Beauly Basin and Ness Estuary are grouped with the upper two stationsa from the Dornoch Firth and doubtless this is due to the low salinity and high proportion of estuarine species. The Inverness/Beauly Firth is the most heterogeneous and stations group with those of the other firths. The Cromarty and Dornoch Firths have such different faunas that they only combine at a low level of similarity. (See also W89-00775) (Alexander-PTT)
W89-00784

REGULATION OF POLLUTION: CONTROLS AND RESPONSIBILITIES,
Highland River Purification Board, Dingwall (Scotland).
For primary bibliographic entry see Field 6E.
W89-00786

MONITORING THE MORAY FIRTH ENVIRONMENT,
Marine Lab., Aberdeen (Scotland).
For primary bibliographic entry see Field 5C.
W89-00787

POLLUTION CONTROL AND ENVIRONMENTAL PLANNING FOR THE BEATRICE OILFIELD AND NIGG OIL TERMINAL,
Britoil PLC, Aberdeen (Scotland).
For primary bibliographic entry see Field 5G.
W89-00788

WATER QUALITY IN THE INVERNESS AND BEAULY FIRTHS,
Highland River Purification Board, Dingwall (Scotland).
For primary bibliographic entry see Field 5B.
W89-00789

HYDROCARBONS IN NIGG BAY SEDIMENTS,
M-Scan Ltd., Ascot (England).
For primary bibliographic entry see Field 5B.
W89-00790

HYDROCARBON AND POLLUTANT LEVELS IN THE CROMARTY FIRTH,
Highland River Purification Board, Dingwall (Scotland).
For primary bibliographic entry see Field 5B.
W89-00791

DEGRADATION OF LOW-TOXICITY OIL-BASED DRILLING MUD IN BENTHIC SEDIMENTS AROUND THE BEATRICE OILFIELD,
M-Scan Ltd., Ascot (England).
For primary bibliographic entry see Field 5B.
W89-00792

DEVELOPMENT OF MASS BLOOMS OF PHOTOSYNTHETIC BACTERIA ON SHELTERED BEACHES IN SCAPA FLOW, ORKNEY ISLANDS,
Dundee Univ. (Scotland). Dept. of Biological Sciences.
R. A. Herbert.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 87, No. 1/2, p 15-25, 1985. 7 fig, 26 ref.

Descriptors: *Scotland, *Scapa Flow, *Beaches, *Orkney Islands, *Anaerobic bacteria, *Heterotrophic bacteria, *Coastal waters, Metabolites, Biodegradation, Microbial degradation, Microbiological studies, Microorganisms, Bacteria, Metabolism, Eutrophication, Photosynthesis, Sulfur compounds, Metabolism.

Mass blooms of purple sulfur bacteria belonging to the genera Thiocapsa and Chromatium develop in localized areas at the sand/air interface on a number of sheltered beaches in Scapa Flow each summer. These anaerobic bacteria grow phototrophically using H2S as e(-) donor and develop in association with other groups of phototrophic and heterotrophic bacteria. Oxygen consumption by the heterotrophs is greater than O2 production by the algae and diffusion from the surface and this rapidly leads to anaerobic conditions in the subsurface sediments. Under these conditions, significant populations of sulfate reducing bacteria develop and reduce SO4(2-) to S(2-) during the anaerobic oxidation of low molecular weight organic substrates. Sulfide generated in this process is used as the e(-) donor in photosynthesis by the purple sulfur bacteria and in turn is re-oxidized to SO4(2-). Sulfate reduction is dependent upon the availability of oxidizable low molecular organic substrates which are produced, as metabolic end-products, during the microbial decomposition of algal detritus. Blooms of Thiocapsa and Chromatium spp. were most pronounced on beaches such as Scapa, Waulkmill and Swanbister, which in localized areas, have high total organic carbon contents (5-12% w/w). The factors regulating the development of these localized mass developments of anaerobic phototrophic bacteria in apparently aerobic environments are discussed. (Author's abstract)
W89-00795

MARINE POLLUTION IN ORKNEY,
Marine Lab., Aberdeen (Scotland).
For primary bibliographic entry see Field 5G.
W89-00796

SEA AND FRESH WATERS,
Marine Lab., Aberdeen (Scotland).
A. D. McIntyre.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 87, No. 3/4, p 139-150, 1986. 2 fig, 5 tab, 15 ref.

Descriptors: *Scotland, *Fisheries, *Coastal waters, Economic aspects, Species composition, Resources development, Natural resources, Water pollution effects, Fish, Aquaculture, North Sea.

The pattern of the current Scottish sea fishery is described in terms of landings, value and species. The contribution from fresh water and from aquaculture is also outlined and the possibilities of distant water fisheries noted. The stability of the resource base is examined, and the effects of pollution assessed. For the future of fisheries, the importance of adequate management arrangements coupled with an understanding of how fishing pressure and fluctuations affect the stocks is emphasized. Despite some ocean dumping around the United Kingdom and the continuing exploitation of North Sea oil resources, marine pollution is likely to remain a localized problem and should not be regarded as a significant long-term threats to fish stocks in Scottish waters. (Alexander-PTT)
W89-00797

GEOGRAPHY OF THE ESTUARY AND FIRTH OF CLYDE,
Glasgow Univ. (Scotland). Dept. of Geography.
J. Tivy.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 90, p 7-23, 1986. 6 fig, 17 ref.

Descriptors: *Scotland, *Clyde Estuary, *Firth of Clyde, *Geography, *Economic aspects, *History, *Fisheries, Water resources development, Resources development, Natural resources, Estuaries, Rivers, Navigable waters, Long-term planning, Coastal waters.

The relative resource value and use of the Estuary and Firth of Clyde have varied through time. Until the eighteenth century the estuary was difficult to navigate. The firth, with its rich fishing grounds and sheltered harbors, was the focus of early settlement. However, increasing trade with the Americas, larger ships and growing competition between Glasgow and the more accessible ports of Greenock and Dumbarton stimulated plans to improve the navigability of the estuary. This was achieved by deepening and widening the main channel, a process which continued as the size of ships increased and more sophisticated techniques of river improvement developed. Within a century and a half the bed of the estuary was transformed from an obstacle to navigation into a major water-route, from which the largest passenger liners in the world were launched. Since the Second World War the relative resource values of the estuary and the firth have changed with the increase in air travel, the decline of ship building and heavy industry on the Clyde, and the increase in the size of cargo vessels. The economic focus shifted from the estuary to the natural, deepwater harbors of the firth. At present redevelopment of derelict docklands and industrial sites along the estuary is taking place, while the firth is suffering from the effects of economic recession. Planning is now being increasingly directed toward the development of the amenity, recreational and tourist potential of both the estuary and the firth. (Author's abstract)
W89-00798

GEOLOGICAL AND GEOMORPHOLOGICAL SETTING OF THE ESTUARY AND FIRTH OF CLYDE,
Glasgow Univ. (Scotland). Dept. of Geography.
W. G. Jardine.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 90, p 25-41, 1986. 3 fig, 60 ref.

Descriptors: *Scotland, *Geologic history, *Estuaries, *Geomorphology, *Clyde Estuary, *Firth of Clyde, *Geohydrology, Coastal waters, Shorelines, Sea level, Sedimentation, Glaciers, Outwash, Estuarine sediments.

In late-Precambrian and early Palaeozoic times, the Clyde Sea Area lay at the junction of a major land mass and the Iapetus Ocean. Closure of the Ocean on its northwestern margin corresponded broadly with initiation of the Highland Boundary and Southern Uplands Faults and formation of southwest-northeast oriented basins of continental sedimentation. Northwest-southeast fractures of the Clyde Belt, along which the Northeast Arran and Southwest Arran troughs of the firth are emplaced, developed across the southwest-northeast Caledonoid grain in Carboniferous-Permian times. The firth and estuary began to assume their distinctive forms in Tertiary times. The area experienced several major glaciations during the Quaternary Period. Late Devensian effects are most distinct: overdeepening of the firth to depths exceeding -160 m OD; deposition of till and meltwater sediments up to 80 m in thickness. Clyde Beds, fossiliferous clays and silty sands up to 15 m in thickness, accumulated about 13,150-10,000 BP yr in subarctic marine waters in the firth, estuary and Paisley embayment, and in the Lomond basin prior to the Loch Lomond Stadial. The Holocene marine transgression, which produced further modifications in shoreline position, e.g. in Ayrshire, the Paisley embayment and the Lomond basin, was followed by marine regression due to isostatic land rebound. (Author's abstract)
W89-00799

CLIMATE OF THE ESTUARY AND FIRTH OF CLYDE,
University of Strathclyde, Glasgow (Scotland). Dept. of Geography.
K. Smith.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 90, p 43-54, 1986. 6 fig, 3 tab, 12 ref.

Descriptors: *Scotland, *Clyde Estuary, *Firth of Clyde, *Climatology, *Meteorological data collection, *Seasonal variation, Temperature effects, Coastal waters, Tidal effects, Water currents, Estuaries, Scotland, Sunshine, Wind.

The climatic character of the shoreline environment of the Clyde Estuary and the Firth of Clyde (Scotland) is analyzed with emphasis on the contrasts between the upper estuary and the Clyde coast. The zone within 5 km of the coast is described in terms of wind; sunshine and visibility; temperature; clouds, humidity, and evaporation; and precipitation. The climate of the Estuary and Firth of Clyde is predominantly mild, dry, and sunny compared to other locations farther inland and at higher elevations in the same latitude of Scotland. Along the coast the growing season (defined as mean daily temperture above 5-6 C) is almost 300 days/yr. This area contains many recreational developments and has the best-developed sea breeze mechanism in Scotland. (Alexander-PTT)
W89-00800

FRESH WATER INFLOWS TO THE FIRTH OF CLYDE,
Clyde River Purification Board, East Kilbride (Scotland).
T. Poodle.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 90, p 55-66, 1986. 8 fig, 2 tab, 2 ref.

Descriptors: *Estuaries, *Rainfall, *River flow, *Scotland, *Clyde Estuary, *Firth of Clyde, Seasonal variation, Coastal waters, Weather data collections, Estuaries, Rivers, Rainfall-runoff relationships, Flood frequency, Low flow.

Rainfall and river flow data were used to calculate the fresh water input to the Firth of Clyde at key locations. The major average inflows are from the upper firth to Toward Point (156.0 cu m/sec, 46% of the total), Ayrshire (51 cu m/sec, 15%), and directly to the sea (45 cu m/sec, 13%). Freshwater inflow can easily vary within a ration of 1000 to 1 between high and low flow. Generally the wettest months are November, December, and January and the driest months are May, June, and July. It is suggested that there have been more occurrences of consecutive days of low flow at and below the 95th percentile flow in recent years than would be expected in the long term. (Alexander-PTT)
W89-00801

CLYDE SEA HYDROGRAPHY,
Dunstaffnage Marine Research Lab., Oban (Scotland).
A. Edwards, M. S. Baxter, D. J. Ellett, J. H. A. Martin, and D. T. Meldrum.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 90, p 67-83, 1986. 11 fig, 26 ref.

Descriptors: *Scotland, *Hydrography, *Clyde Estuary, *Firth of Clyde, *Coastal waters, *Saline-freshwater interfaces, *Tidal effects, Water currents, Thermocline, Seasonal variation, Estuaries, Wind, Sea lochs, Sediment grading, Density currents.

A front on the Great Plateau separates tidally mixed water of the North Channel from quieter less saline surface layers of the Outer Firth. These water bodies exchange about 16,000 cu m/s, leading to a residence time of two months in the Outer Firth surface layers. The position of the front is determined by the balance of mixing and buoyancy supply. The wind modulates weak tidal currents in the Outer Firth by driving surface currents and setting up deeper compensation flows. Deep water in the Arran Deep and Kilbrannan Sound is irregularly renewed by inflow of dense water over the Eastern Plateau from autumn to spring but stagnates in summer below a thermocline. A minor part of this renewal comes over the Davaar sill into Kilbrannan Sound. Bottom water of the fjordic sea-lochs is isolated in summer and renewed during the winter. The renewals occur by density currents flowing in from the sills and these produce a characterizing grading of the bottom sediments from coarse to fine away from the sills. (Author's abstract)
W89-00802

WATER MOVEMENT AND THE SIMULATION OF STORM SURGES IN THE FIRTH OF CLYDE,
University of Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering.
J. M. Townson, and R. H. F. Collar.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 90, p 85-96, 1986. 7 fig, 6 tab, 23 ref.

Descriptors: *Storm surges, *Clyde Estuary, *Firth of Clyde, *Estuaries, *Scotland, *Hydrodynamics, *Tidal effects, *Water currents, Numerical analysis, Seasonal variation, Mathematical studies, Mathematical equations, Coastal waters.

The basin mechanisms governing the general circulation of water in the Firth of Clyde (Scotland) are reviewed with particular reference to their changing relative importance throughout the system, including the inner estuary. A numerical model for the depth-integrated equation of motion is applied to the surges recorded in 1972 and 1979. First a simulation of tidal motion was conducted; once this was established, the additional input for storm surges was superimposed on the model. This input consisted of: (1) Then external surge, which was the displacement variation at the entrances caused by the wind's stress and pressure field history outside the model, and was obtained by substracting the predicted harmonic tide from the observed record at the entrance and (2) the wind stress variation during the surge at grid points throughout the model, together with the local effect of low atmospheric pressure treated as equivalent static change in water level. It is concluded that two-third of the magnitude of the storm surge in this area is extremely generated. The balance, excluding pressure, consists of wind stress effects over the Clyde Sea area. (Alexander-PTT)
W89-00803

EFFLUENT DISPOSAL AND THE PHYSICAL ENVIRONMENT,
Clyde River Purification Board, East Kilbride (Scotland).
For primary bibliographic entry see Field 5E.
W89-00804

HYDROGRAPHY OF IRVINE BAY AND ITS RELATION TO THE CLYDE SEA AREA,
Imperial Chemical Industries Ltd., Brixham (England). Brixham Lab.
R. E. Lewis.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 90, p 117-126, 1986. 6 fig, 4 tab, 10 ref.

Descriptors: *Scotland, *Hydrography, *Irvine Bay, *Clyde Sea, *Water currents, *Tidal effects, Saline-freshwater interfaces, Estuaries, Rivers, Coastal waters, Density, Dispersion, Clyde Estuary, Garnock Estuary, Tracers, Weather.

Over the period 1973-75, detailed studies were made of the water density structure and circulation of Irvine Bay. Observations showed that offshore waters were influenced by water originating in the Clyde Estuary and the inshore waters were affected by brackish outflow from the Irvine-Garnock Estuary. Long period current records indicated that the movement of water in Irvine Bay and the eastern Clyde Sea Area was particularly responsive to meteorological forcing. Based on data for 1974, the estimated annual mean longshore drift was about 5.0 cm/s and directed towards the northwest. Studies of a tracer dye patch over a 1.5 day period showed that horizontal dispersion was influenced by vertical shears in the mean current and that vertical mixing was inhibited by a density interface at less than 4 m depth. The average longitudinal and transverse dispersion coefficients were 2.17 sq m/s and 0.25 sq m/s respectively. (Author's abstract)
W89-00805

BIOTURBATION, MICROBIAL ACTIVITY AND SEDIMENT PROPERTIES IN AN ESTUARINE ECOSYSTEM,
Glasgow Univ. (Scotland). Dept. of Zoology.
P. S. Meadows, and A. Tufail.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 90, p 129-142, 1986. 9 fig, 2 tab, 50 ref. SERC Grants GR/B.8872.2 (Z3), and 81512396; NERC Grants GT4/80/ALS/9, GT4/81/ALS/42, and GST/02/54.

Descriptors: *Sediments, *Clyde Estuary, *Firth of Clyde, *Scotland, *Macroinvertebrates, *Estuarine sediments, *Bioturbation, Ecological effects, Environmental effects, Microorganisms, Physical properties, Spatial distribution, Hydrogen ion concentration, Estuaries, Rivers, Coastal waters, Oxidation-reduction potential, Diagenesis.

Macrobenthic bioturbation and microbial activity can have major ecological effects on present day marine sediments some of which are also seen in the fossil record. The coastal and estuarine sediments in the Clyde Estuary area contain very high densities of benthic macroorganisms and microorganisms. These organisms have dramatic effects on the physical and chemical properties of sediments, and field and laboratory studies have shown that many geotechnical and geochemical properties of sediments are dictated by them. The effects can be on a microscale of a few millimeters horizontally or vertically (micro-spatial variation), or can have large scale consequences over hundreds of meters (macro-spatial variation). Sediment stability (shear strength and critical erosion velocity), permeability and particle sedimentation are all altered by macro-invertebrate bioturbation or microbial activity, and many chemical properties such as Eh and pH may be influenced in a similar manner. Biological activity may therefore play a major role in modifying sediment geotechnics and early sediment diagenesis. It also has direct relevance to the siting of man-made structures on the sea-bed and to sediment stability and transport in estuaries. In situ seeding experiments may lead to biological control and manipulation of these phenomena. (Author's abstract)
W89-00806

ATTACHED ALGAE OF THE CLYDE AND GARNOCK ESTUARIES,
Heriot-Watt Univ., Edinburgh (Scotland). Dept. of Brewing and Biological Sciences.
For primary bibliographic entry see Field 5C.
W89-00807

EPILITHIC DIATOMS OF THE CLYDE ESTUARY,
Paisley Coll. of Tech. (Scotland). Dept. of Biology.
R. O. McLean, T. A. K. Gow, J. Webster, A. Arthur, and D. J. Curtis.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 90, p 151-156, 1986. 2 fig, 3 tab, 7 ref.

Descriptors: *Scotland, *Diatoms, *Clyde Estuary, *Firth of Clyde, *Species composition, Salt tolerance, Coastal waters, Microorganisms, Microbiological studies, Photosynthesis, Estuaries, Rivers, Algae, Clones, Taxonomy, Species diversity, Niches, Ecology.

Epilithic diatom communities of the Clyde (Scotland) Estuary demonstrated no spring or autumn bloom. Species diversity and dominance were stable at the ends of the estuary and fluctuated through the year in mid-estuary. Species succession differed from regions where one species dominated throughout the year to those where the dominant species was constantly changing. In all, 307 species were recorded, 29 very rare, 172 rare, and 19 abundant, some having wide niche breadth ($B > 60$). Narvicula mutica var. cohnii (Hilse) Grun. and var. mutica kutz were difficult to distinguish in terms of valve morphology, as intermediate forms existed. In the estuary, smaller valves occurred towards the freshwater end. Two clones, originating from a 12-micron and a 26-micron valve (length) corresponding to descriptions of

var. cohnii and var. mutica respectively, behaved similarly in culture throughout a range of salinity, in terms of size expression, suggesting no taxonomic difference. Diatom community photosynthesis was affected by salinity, reflecting the site of origin. (Author's abstract)
W89-00808

STATUS OF FISH POPULATIONS IN THE CLYDE ESTUARY,
Clyde River Purification Board, East Kilbride (Scotland).
A. R. Henderson, and J. D. Hamilton.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 90, p 157-170, 1986. 6 fig, 1 tab, 32 ref.

Descriptors: *Clyde Estuary, *Firth of Clyde, *Recovery, *Water pollution effects, *Species composition, *Population dynamics, Temporal distribution, Spatial distribution, Seasonal variation, Biomass, Salt tolerance, Dissolved oxygen, Toxicity, Salinity, Estuaries, Rivers, Mortality, Organic loading, Barriers.

Changes in the status of fish populations in the Clyde Estuary between Woodhall and Glasgow since 1978 are described. Data are presented on species composition and distribution, temporal and spatial fluctuations in abundance and biomass and length frequency data for certain species are analyzed. The seaward part of the estuary is colonized by marine and euryhaline marine species dominated by flounder, while the 'city reaches' have a fresh water component dominated by three-spined stickleback and eel in addition to several euryhaline species, e.g. sand-goby and saithe. The extent of biological recovery of the estuary from severe organic pollution can be gauged from the presence now of thirty-four species, including nineteen in the city reaches which were virtually fishless in the mid nineteenth century. The upper estuary is now able to support resident and migratory fish for much of the year, but species composition and abundance are markedly affected by seasonally variable fresh water flows to the estuary affecting primarily dissolved oxygen and salinity, leading to mortalities among resident species and providing a barrier to migrants. (Author's abstract)
W89-00809

RECENT CHANGES IN NUMBERS OF WADERS ON THE CLYDE ESTUARY, AND THEIR SIGNIFICANCE FOR CONSERVATION,
Glasgow Univ. (Scotland). Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W89-00810

PATTERNS OF ASSOCIATION BETWEEN BIRDS AND INVERTEBRATES IN THE CLYDE ESTUARY,
Liverpool Univ. (England). Dept. of Zoology.
D. B. A. Thompson, D. J. Curtis, and J. C. Smyth.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 90, p 185-201, 1986. 2 fig, 4 tab, 83 ref.

Descriptors: *Water birds, *Clyde Estuary, *Scotland, *Firth of Clyde, *Water pollution effects, *Species composition, *Population dynamics, *Food habits, *Food chains, Macroinvertebrates, Coastal waters, Seasonal variation, Tidal effects, Predation, Ecology, Regression analysis, Estuaries.

Until 5 yr ago, the tidal flats of the Clyde Estuary (Scotland) held internationally and nationally important populations of ducks and waders. The pattern of association between the Clyde's birds and their prey was examined by evaluating the extent to which the distribution of birds is related to that of benthic invertebrates, heterospecific birds, season, and tidal state. Stepwise multiple regression analysis indicated that heterospecifics had effects on bird distributions over-riding those of prey. In summer, the significant independent variables explained 41-61% variation in bird density and 33% variation in bird feeding hours; in winter they explained 17-35% and 29-32%, respectively. The amount of variation explained was greater during flow than ebb tides, and the number of species for which some of the variation was explained was greater in winter than in summer. Three associations, each consisting of two bird species, are suggested: redshank with lapwing, dunlin with mallard, and shelduck with gulls. Explanations are given for some of the mechanisms underlying the above patterns and areas for more detailed observational and experimental work are pointed out. (Author's abstract)
W89-00811

SEASONAL STUDIES ON THE PHYTOPLANKTON AND PRIMARY PRODUCTION IN THE INNER FIRTH OF CLYDE,
Glasgow Univ. (Scotland). Dept. of Botany.
A. D. Boney.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 90, p 203-222, 1986. 12 fig, 33 ref.

Descriptors: *Clyde Estuary, *Firth of Clyde, *Seasonal variation, *Phytoplankton, *Primary productivity, Climatology, Weather data collections, Coastal waters, Tidal effects, Zooplankton, Food habits, Water currents, Estuaries, Rivers, Diatoms, Population dynamics, Biomass.

Analysis of the factors influencing the seasonal changes in biomass of the 'net' phytoplankton of the river Firth of Clyde (Scotland) in 1972-73 showed that the dynamics of the spring waxing of the diatom populations were controlled by narrow 'windows' of climatic events, and that subsequent fluctuations in cell numbers were linked with the interplay between zooplankton grazing and wind induced dispersion. Data for 1976-77, set against a similar background of events with the 'net' plankton, showed that the nanophytoplankton constituted a less variable biomass through the seasons and, on an annual basis, contributed some 50% of the total carbon fixed. (Author's abstract)
W89-00812

PHYTOPLANKTON ECOLOGY OF THE FIRTH OF CLYDE SEA-LOCHS STRIVEN AND FYNE,
Dunstaffnage Marine Research Lab., Oban (Scotland).
P. Tett, R. Gowen, B. Grantham, K. Jones, and B. S. Miller.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 90, p 223-238, 1986. 9 fig, 4 tab, 25 ref.

Descriptors: *Scotland, *Nitrates, *Clyde Estuary, *Firth of Clyde, *Fish hatcheries, *Phytoplankton, *Eutrophication, Seasonal variation, Coastal waters, Population dynamics, Salt tolerance, Aquatic plants, Aquatic habitats, Limiting nutrients, Ecological effects, Algae, Estuaries, Diatoms, Biomass.

Lochs Fyne and Striven are deep-silled fjords opening into the northern Firth of Clyde. They receive relatively little freshwater from local runoff, have a relatively low rate of tidal exchange, and undergo periods of deep water stagnation. Both contain fish farms which have lost stock because of phytoplankton blooms. Loch Striven was investigated in detail in 1980. Observations are also reported for 1979 and 1981, and for Loch Fyne from 1980-1982. Most stratification in Striven is due to salinity layering, but most of the freshwater in the loch probably originates in the Clyde Estuary and is associated with high concentrations of nitrate. Typical phytoplankton biomasses in Striven are the same as those in the western seaboard Loch Creran, but maxima exceed those in Creran. In addition to a red tide of Gyrodinium aureolum in September, 1980, three periods of high biomass seem to be a regular feature of the phytoplankton calendar in Striven. The spring increase takes place in March or early April, is dominated by the diatom Skeletonema costatum, and probably depends on the stabilizing effects of reduced near-surface salinities. A summer flourishing of Leptocylindrus danicus and dinoflagellates is also associated with near-surface salinity layering. A late spring bloom of diatoms, dinoflagellates and small flagellates, some ichthyotoxic, appears to be related to the occurrence of thermohaline stratification and near-surface nutrient depletion; on some occasions loch-head upwelling may also have been involved. Insofar as data are available, the ecology of phytoplankton in Loch Fyne appears similar to that in Loch Striven. (Author's abstract)
W89-00813

ZOOPLANKTON INVESTIGATIONS IN THE FIRTH OF CLYDE,
Marine Lab., Aberdeen (Scotland).
J. A. Adams.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 90, p 239-254, 1986. 4 fig, 1 tab, 69 ref.

Descriptors: *Scotland, *Clyde Estuary, *Firth of Clyde, *Zooplankton, *Coastal waters, Biomass, Crustaceans, Population dynamics, Aquatic habitats, Aquatic animals, Microorganisms, Seasonal variation, Estuaries, History.

Zooplankton investigations in the Firth of Clyde can be considered as starting in 1885, when the Fishery Board for Scotland built a laboratory at Tarbert and the Granton based Scottish Marine Station extended its studies to the west coast. The work of both groups, and their successors, waxed and waned, with a particularly active period starting in the early 1920s, when the Millport Station received government aid. Although the euphausiids Meganyctiphanes norvegica and Thysanoessa raschii are important in the deep waters around Arran and in Loch Fyne, in general, copepods are the most important pelagic crustaceans. Of these Calanus occurs in enormous numbers in surface waters in May and June. Thereafter it is found mainly in deep waters such as those of Loch Fyne. Other abundant copepods are Pseudocalanus elongatus, Acartia clausi and Oithona similis which are particularly characteristic of the area extending from Kilbrannan Sound via the east of Arran to the upper Firth of Clyde. In these areas the peak standing stock of the large zooplankters (as caught by a 250 micron mesh net) is about 5, occasionally 8, g dry weight per 100 cu m, occurring from April to July. The smaller zooplankters (as caught by a 68 micron mesh net) add a further 1.3 g dry weight per 100 cu m. (Author's abstract)
W89-00814

ECOLOGY OF MACROALGAE IN THE FIRTH OF CLYDE,
Liverpool Univ., Port Erin (England). Dept. of Marine Biology.
T. A. Norton.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 90, p 255-269, 1986. 4 fig, 3 tab, 66 ref.

Descriptors: *Scotland, *Algae, *Clyde Estuary, *Firth of Clyde, *Aquatic plants, Coastal waters, Plant physiology, Population dynamics, Biomass, Food habits, Food chains, Reproduction, Estuaries.

The distribution of seaweeds in the Firth of Clyde is described. The patterns of algal distribution are discussed in relation to propagule dispersal and recruitment, and the physiological ecology of the plants. Particular attention is given to the influence of biotic factors: competition, grazing by invertebrates and the effects of man. There seems to be a slight but general reduction in the diversity of the seaweed since 1900 in the Firth of Clyde but it is difficult to determine whether there have been significant changes in the abudance of the surviving species because of a lack of earlier quantitative assessemnts. (Alexander-PTT)
W89-00815

SEAWEED-ASSOCIATED ANIMAL COMMUNITIES IN THE FIRTH OF CLYDE, WITH SPECIAL REFERENCE TO THE POPULATION BIOLOGY OF THE AMPHIPOD HYALE NILSSONI (RATHKE),
University Marine Biological Station, Millport (Scotland).
P. G. Moore.
Proceedings of the Royal Society of Edinburgh

(Section B), Vol. 90, p 271-286, 1986. 9 fig, 3 tab, 66 ref.

Descriptors: *Scotland, *Amphipods, *Algae, *Clyde Estuary, *Firth of Clyde, *Aquatic animals, Aquatic habitats, Coastal waters, Species composition, Population dynamics, Biomass, Seasonal variation, Reproduction, Food habits, Food chains, Estuaries.

Present knowledge of animal communities associated with the algae of the Firth Clyde is briefly reviewed. New work on Hyale nilssoni (Rathke), the commonest amphipod inhabiting high littoral seaweeds, describes the life-history characteristics over three years of a population associated with Pelvetia. Seasonal changes in growth rate, sex ratio and breeding status are described. Fecundity was investigated and data on brood and egg sizes compared with populations from other latitudes. In the early spring, when Hyale growth begins to accelerate, the quality of the food available (the Pelvetia) is at tis maximum. The seasonal cycle of the weight change in male Hyale closely follows the seasonal cycle of Pelvetia NAA content. The tendency of femal amphipods of the 'winter generation' to produce bigger eggs and more of them than females of the 'summer generation' may also be due to seasonal differences in food quality and N availability. Hyale may serve as a promoter of Pelvetia zygotes by bringing them into contact with the most protected microhabitats (in cracks and crevices in rocks) where they would have a better chance of adherence. (Alexander-PTT)
W89-00816

LONG-TERM CHANGES IN SOME BENTHIC SPECIES IN THE FIRTH OF CLYDE, WITH PARTICULAR REFERENCE TO TELLINA TENUIS DA COSTA,
Dunstaffnage Marine Research Lab., Oban (Scotland).
For primary bibliographic entry see Field 5C.
W89-00817

BIOLOGY OF HARPACTICOID COPEPODS IN THE MEIOFAUNA OF SHALLOW SUBTIDAL SANDS,
Dunstaffnage Marine Research Lab., Oban (Scotland).
B. L. S. Hardy, and P. R. O. Barnett.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 90, p 303-316, 1986. 5 fig, 3 tab, 36 ref.

Descriptors: *Scotland, *Firth of Clyde, *Copepods, *Seasonal variation, *Population dynamics, Aquatic animals, Food habits, Food chains, Temperature effects, Animal physiology, Reproduction, Biology, Coastal waters.

An account is given of the benthic harpacticoid copepods of a medium grade subtidal sand at a depth of 8.5 m (below chart datum) off the Ayrshire coast at Hunterston. It is the first account of seasonal changes in subtidal harpacticoids in the Firth of Clyde. Most of the population is restricted to the top 1 cm layer of sand and this is considered to be related to food availability. There were considerable variations in total densities with largest numbers occurring in late June, as seawater temperatures increased rapidly towards the summer maxima. Two species examined in detail, Asellopsis hispida and Harpacticus flexus each had one distinct period of reproduction during the year. Gravid females appeared first during the coldest months (January and February) followed by large numbers of copepodites from late April to June, culminating in large numbers of adults in June. Adult males clasped female stages only in May and June, after the main period of egg production. It is thought that viable sperm is carried by the adult females for about six to seven months, supposedly until the next period of egg production the following year. Adults of Harpacticus flexus are thought to be an important source of food for juvenile and small fish, particularly during July. (Author's abstract)
W89-00818

BENTHIC FAUNA OF SANDY BAYS, WITH PARTICULAR REFERENCE TO IRVINE BAY,
Marine Lab., Aberdeen (Scotland).
For primary bibliographic entry see Field 5C.
W89-00819

BENTHOS OF THE DEEPER SEDIMENTS OF THE FIRTH OF CLYDE, WITH PARTICULAR REFERENCE TO ORGANIC ENRICHMENT,
Dunstaffnage Marine Research Lab., Oban (Scotland).
For primary bibliographic entry see Field 5C.
W89-00820

MUD-BURROWING MEGAFAUNA OF THE CLYDE SEA AREA,
University Marine Biological Station, Millport (Scotland).
R. J. A. Atkinson.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 90, p 351-361, 1986. 2 fig, 69 ref.

Descriptors: *Bioturbation, *Scotland, *Burrowing, *Crustaceans, *Clyde Estuary, *Firth of Clyde, Remote sensing, Aquatic animals, Aquatic habitats, Spatial distribution, Fish physiology, Fish behavior.

Underwater television, remote photography and SCUBA diving have revealed that Clyde Sea Area sublittoral muds are extensively bioturbated by megafaunal species that construct conspicuous burrows. These species are mainly decapod crustaceans and fish, each with a characteristic burrow configuration and optimum horizon for excavation. Burrow structures have been revealed by resin casting and densities and distributions have been studied using camera and SCUBA techniques. Burrowing behavior has been investigated by field and laboratory studies, while physiological studies of some species have shown respiratory adaptations to the burrowing mode of life. Megafaunal burrowing appears to be an important determinant of benthic community structure. (Author's abstract)
W89-00821

POPULATION DYNAMICS OF SEABIRDS IN THE FIRTH OF CLYDE,
Glasgow Univ. (Scotland). Dept. of Zoology.
P. Monaghan, and B. Zonfrillo.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 90, p 363-375, 1986. 6 fig, 39 ref.

Descriptors: *Scotland, *Water birds, *Clyde Estuary, *Firth of Clyde, *Population dynamics, Reproduction, Food habits, Food chains, Seasonal variation, Estuaries, Rivers, Species composition.

Marked interspecific differences in recent population trend have been recorded for seabirds breeding in the Firth of Clyde. Auk populations have remained comparatively stable, while considerable reductions have taken place in tern and kittiwake numbers. Stags, cormorants, gannets and great black-backed gulls have all increased, as have fulmars and herring gulls. The striking increases in the latter two species are considered in detail. To some extent, these population changes can be related to differences in the feeding ecology of the various seabirds; in particular the variation in the number of breeding terns is related to variation in food availability. (Author's abstract)
W89-00822

TRACE METALS IN THE COMMON MUSSEL MYTILUS EDULIS (L.) IN THE CLYDE ESTUARY,
Clyde River Purification Board, East Kilbride (Scotland).
For primary bibliographic entry see Field 5B.
W89-00823

USE OF THE CLYDE ESTUARY AND FIRTH FOR THE DISPOSAL OF EFFLUENTS,
Clyde River Purification Board, East Kilbride (Scotland).
For primary bibliographic entry see Field 5E.
W89-00824

BIOLOGY AND MANAGEMENT OF HERRING AND OTHER PELAGIC FISH STOCKS IN THE FIRTH OF CLYDE,
Marine Lab., Aberdeen (Scotland).
R. S. Bailey, D. W. McKay, J. A. Morrison, and M. Walsh.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 90, p 407-422, 1986. 5 fig, 6 tab, 29 ref.

Descriptors: *Herring, *Clyde Estuary, *Firth of Clyde, *Fish hatcheries, *Scotland, *Reproduction, Fish physiology, Population dynamics, Seasonal variation, Estuaries.

The herring population inhabiting the Firth of Clyde has supported an important fishery for hundreds of years. The basis for this fishery was until recently a stock of spring-spawning herring which spawn on Ballantrae Bank in the period February-April and which was investigated intensively by means of larval surveys from 1958 to 1979, when it had decreased to a very low level. In the late 1960s there was evidence of a change in the composition of the landings and during the 1970s and in the present decade the majority of fish caught have been of autumn-spawned origin. There is no evidence of significant autumn spawning in the Firth of Clyde and autumn-spawning herring in advanced stages of maturation appear to leave the Clyde, returning by the time the fishery opens the following spring. The spawning origin of autumn-spawned herring in the Clyde has been investigated by tagging experiments, and recaptures have been made in the Irish Sea, off the northwest Irish coast and further north along the west coast of Scotland. However the spawning area of the majority of the fish is unknown. The herring fisheries in the Clyde, originally carried out by ring-net and anchored drift-net but now mainly by pair-trawl, have been managed by closed seasons and in the past few years by total allowable catch regulations under the control of the European Community. There is also a population of sprats in the Firth of Clyde which supports a small fishery and spawning of this species takes place earlier in the Clyde than elsewhere around Scotland. Mackerel also make annual incursions into the Clyde and support a small summer fishery. Factors affecting the abundance of pelagic fish species in the Clyde could be either natural or man-made. Recruitment to spring-spawning herring stocks throughout the northeast Atlantic has been at a low level recently, which would suggest natural changes. (Alexander-PTT)
W89-00825

RECENT CHANGES IN THE STATUS OF SOME CLYDE VERTEBRATES,
Scottish Natural History Museum, Kilbarchan.
For primary bibliographic entry see Field 5C.
W89-00826

CONSERVATION OF NATURAL RESOURCES,
Nature Conservancy Council, Edinburgh (Scotland).
For primary bibliographic entry see Field 6E.
W89-00827

MIGRATORY SALMONIDS OF THE ESTUARY AND FIRTH OF CLYDE,
Clyde River Purification Board, East Kilbride (Scotland).
For primary bibliographic entry see Field 5G.
W89-00828

DISTRIBUTION OF PLAICE EGGS AND LARVAE IN THE CLYDE SEA AREA,
Heriot-Watt Univ., Edinburgh (Scotland). Dept. of Biological Sciences.
M. G. Poxton.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 90, p 491-499, 1986. 4 fig, 5 tab, 9 ref.

Descriptors: *Plaice, *Population dynamics, *Scotland, *Clyde Estuary, *Firth of Clyde, Fish physiology, Reproduction, Food chains, Seasonal variation, Estuaries, Rivers, Larvae, Fish eggs.

Information concerning the abundance and distribution of plaice Pleuronectes platessa L. eggs and larvae has been gathered from the examination of old records and from cruises carried out for this purpose. Additional information on the spawning of plaice is presented from the capture of ripe specimens. Plankton samples have been taken in the Clyde Sea Area over many years by the Department of Agriculture and Fisheries for Scotland. All samples taken since 1950 have been examined and data on plaice eggs and larvae have been extracted and collated. The data have been standardized by expressing all the results in terms of number/100 cu m. The data show that plaice spawn in the Clyde between February and April, with maximum concentrations of eggs and larvae occurring in early March and April, respectively. Although the eggs are widely distributed, they are commonest to the east of Arran, the greatest densities being found off the Heads of Ayr, in Ayr Bay, close to Ailsa Craig and Irvine Bay. The distribution of eggs and larvae appears to correlated well with what is known of the abundance and distribution of the young fish in their nursery areas. (Alexander-PTT)
W89-00829

SALTMARSHES OF THE FIRTH OF CLYDE,
Nature Conservancy Council, Peterborough (England).
J. P. Doody.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 90, p 519-536, 1986. 1 fig, 2 tab, 11 ref, append.

Descriptors: *Salt marshes, *Scotland, *Clyde Estuary, *Firth of Clyde, *Species composition, *Aquatic plants, Physical properties, Estuaries, Rivers, Grazing, Industrial development.

The saltmarshes of the Firth of Clyde are restricted both in area and number. Despite this they exhibit considerable variation in terms of their physical environment, floristic composition and range of plant communities. The absence of grazing at most of the sites has resulted in their exhibiting plant communities atypical of most of the other saltmarshes of western Scotland. Like many other saltmarsh areas they have suffered from reclamation of the older, upper marsh. However, despite this, there are still important transitional communities to non-tidal vegetation. The prevention of further incursions into the sites for roads, industrial development, caravans and the like, is important if these sites are to remain as examples of natural habitats. (Author's abstract)
W89-00830

DYNAMICS OF SALTWATER INTRUSION IN COASTAL CHANNELS,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
F. C. Wang.
Journal of Geophysical Research (C) JGRCEY, Vol. 93, No. 6, p 6937-6946, June 15, 1988. 9 fig, 2 tab, 21 ref.

Descriptors: *Estuaries, *Saline water intrusion, *Coastal waters, *Saline-freshwater interfaces, *Channels, Louisiana, Hydrodynamics, Model studies, Numerical analysis, Flow characteristics, Salinity, Stratification, Mathematical studies, Hydraulics, Velocity.

The dynamic behavior of saltwater intrusion of coastal channels with small tidal range is often dependent upon motions induced by freshwater inflow from the upstream drainage basin. In coastal Louisiana the salinity distribution in channels encompasses well-mixed, partially stratified, and highly stratified phenomena. A two-dimensional, laterally averaged, and semi-implicit hydrodynamic model coupled with a salt flux transport model is developed to quantify the saltwater intrusion due to interactions of freshwater discharge, tidal activity, prevailing wind, and the density gradient caused by variations in salinity. In the model, the coefficients of eddy and salt diffusivity are varied as functions of space and time. The values of coefficients fitted from the field data are comparable to those reported by others. The numerical model, calibrated with independent field data sets, is then applied to predict the changes in the patterns of salinity distribution in channels resulting from changes in channel dimensions. Both computed and field results reveal that the salinity intrusion in coastal channels is highly dependent on the freshwater inflow and the channel dimensions. (Author's abstract)
W89-00833

SATELLITE OBSERVATIONS OF TIDAL UPWELLING AND MIXING IN THE ST. LAWRENCE ESTUARY,
Quebec Univ., Rimouski. Dept. of Oceanography.
Y. Gratton, G. Mertz, and J. A. Gagne.
Journal of Geophysical Research (C) JGRCEY, Vol. 93, No. 6, p 6947-6954, June 15, 1988. 4 fig, 1 tab, 23 ref.

Descriptors: *Water temperature, *Remote sensing, *Tidal effects, *Mixing, *Estuaries, *St. Lawrence River, *Satellite technology, *Upwelling, Thermal properties, Thermocline, Water temperature, Temperature gradient, Wind, Spatial distribution.

Satellite thermal images of the St. Lawrence estuary are used to confirm the existence of a persistent cold spot due to tidal upwelling at the head of the lower St. Lawrence estuary and to show that cold water may be found episodically up to 100 km downstream of the head. This extended cold anomaly may exist in two spatial configurations: one confined to near the south shore, the other being centered over mid-estuary. The various physical agencies likely to contribute to the growth of this anomaly are discussed. It is concluded that wind, internal tides, and advection of cold water from the head region are the most significant contributors. (Author's abstract)
W89-00834

SEA-SURFACE MICROLAYER OF PUGET SOUND: PART I: TOXIC EFFECTS ON FISH EGGS AND LARVAE,
Battelle Pacific Northwest Labs., Sequim, WA. Marine Research Lab.
For primary bibliographic entry see Field 5C.
W89-00853

SEA-SURFACE MICROLAYER OF PUGET SOUND: PART II: CONCENTRATIONS OF CONTAMINANTS AND RELATION TO TOXICITY,
Battelle Pacific Northwest Labs., Sequim, WA. Marine Research Lab.
For primary bibliographic entry see Field 5C.
W89-00854

TOXICITY OF SEA-SURFACE MICROLAYER: EFFECTS ON HERRING AND TURBOT EMBRYOS,
Biologische Anstalt Helgoland (Germany, F.R.)
For primary bibliographic entry see Field 5C.
W89-00855

TOXICITY OF SEA-SURFACE MICROLAYER: EFFECTS OF HEXANE EXTRACT ON BALTIC HERRING (CLUPEA HARENGUS) AND ATLANTIC COD (GADUS MORHUA) EMBRYOS,
Washington Univ., Seattle. School of Fisheries.
For primary bibliographic entry see Field 5C.
W89-00856

CONTAMINANT CONCENTRATIONS AND TOXICITY OF SEA-SURFACE MICROLAYER NEAR LOS ANGELES, CALIFORNIA,
Southern California Coastal Water Research Project, Long Beach.
For primary bibliographic entry see Field 5C.
W89-00857

PEAT ACCUMULATION AND THE SUCCESS OF MARSH PLANTS,
Brown Univ., Providence, RI. Graduate Program in Ecology and Evolutionary Biology.
For primary bibliographic entry see Field 2H.
W89-00909

POPULATION GENETICS OF MYTILUS EDULIS (L.) FROM OSLOFJORDEN, NORWAY IN OIL-POLLUTED AND NON OIL-POLLUTED WATER,
Oslo Univ. (Norway). Inst. of Marine Biology.
For primary bibliographic entry see Field 5C.
W89-01009

RESULTS OF ECOLOGICAL MONITORING OF THREE BEACHES POLLUTED BY THE 'AMOCO CADIZ' OIL SPILL: DEVELOPMENT OF MEIOFAUNA FROM 1978 TO 1984,
Universite de Bretagne-Occidentale, Brest (France). Lab. d'Oceanographie Biologie.
For primary bibliographic entry see Field 5C.
W89-01031

CLEARANCE OF BACTERIA-SIZED PARTICLES BY NATURAL POPULATIONS OF NANOPLANKTON IN THE CHESAPEAKE BAY OUTFLOW PLUME,
Institute of Ecosystem Studies, Millbrook, NY.
G. B. McManus, and J. A. Fuhrman.
Marine Ecology Progress Series MESEDT, Vol. 42, No. 2, p 199-206, February 18, 1988. 5 fig, 3 tab, 35 ref. NSF Grant No. OCE 8545037.

Descriptors: *Particulate matter, *Plankton, *Chesapeake Bay, *Estuarine environment, *Bacteria, *Marine bacteria, *Feeding rates, Environment, Predation, Flagellates, Protozoa, Culturing techniques, Productivity, Mortality.

The uptake of bacteria-sized particles by non-pigmented nanoplankton was measured in late winter (February) and spring (June) in the Chesapeake Bay outflow plume. Small flagellates (11 to 35 cubic microns average cell volume) numerically dominated the grazer community in both seasons, although experiments in June showed that ciliates could also be important bacterivores. Rates of ingestion ranged from 1.8 to 25.0 bacteria/flagellate/h and were significantly correlated with bacterial abundance. Specific clearance rates (body volumes swept clear per hour) of these natural populations of flagellates were similar to those of forms which have been studied in culture. Flagellate community clearance rates were similar to bacterial growth rates in February. In June, however, grazing was much lower than growth, and flagellates removed, on average, only 23% of daily bacterial production. Reasons for this shortfall possibly include other sources of bacterial mortality, discrimination by grazers against the particles, the omission from the grazing measurement of larger, rarer bacterivores (e.g., ciliates), and artifacts resulting from particle egestion. (Author's abstract)
W89-01032

RESPONSE OF BENTHIC MEIOFAUNA TO NUTRIENT ENRICHMENT OF EXPERIMENTAL MARINE ECOSYSTEMS,
Stockholm Univ. (Sweden). Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W89-01033

BACTERIAL PRODUCTION IN FRESH AND SALTWATER ECOSYSTEMS: A CROSS-SYSTEM OVERVIEW,
Institute of Ecosystem Studies, Millbrook, NY.
For primary bibliographic entry see Field 2H.
W89-01034

K-SYSTEMS ANALYSIS FOR DETERMINING THE FACTORS INFLUENCING BENTHIC MICROFLORAL PRODUCTIVITY IN A LOUISIANA ESTUARY, USA,
Louisiana State Univ., Baton Rouge. Coastal Ecology and Fisheries Inst.
G. P. Shaffer.
Marine Ecology Progress Series MESEDT, Vol. 43, No. 1/2, p 43-54, March 24, 1988. 5 fig, 2 tab, 57 ref.

Descriptors: *Productivity, *Benthic environment, *Estuaries, *Marine biology, *Algae, Ecology, Sand, Soil types, Chlorophyll a, Light intensity, Temperature, Water temperature, Salinity, Respiration, Wave height, Tides, Oxygen, Dissolved oxygen, Physical properties, Chemical properties, Mud, Cyanophyta, Diatoms, Chrysophyta, Barataria Estuary.

About 3,000 sediment cores from Barataria Estuary, LA were incubated for a month to determine the importance of and factors influencing benthic microfloral productivity. For the month, benthic microfloral production measured at a subtidal site consisting of muddy sand was almost twice that measured at a sandy intertidal site. However, maximum productivity rates were greatest at the sandy site. Variables monitored included chlorophyll a, light intensity, water temperature, salinity, benthic community respiration, productivity of the water column, biological activity (muddy sand site), wave height (sand site), meteorological tides (wind-induced water levels), tide height, and initial dissolved oxygen. Multi-channel information analysis indicated that the information accounted for in productivity by these variables peaked at slightly less than 7 and 3 d period for the sand site and weak peaks occurred at about 10 and 3 d periods for the muddy sand site. K-systems analysis indicated that the environmental variables acted in combination to influence productivity, and that the combinations changed through time. Physical processes (meteorologic, astronomic, and anthropogenic) largely controlled productivity at the sand site. Productivity at the muddy sand site was influenced by a combination of physical and biological activities. (Author's abstract)
W89-01035

INFLUENCE OF MICROPHYTOBENTHOS ON THE NUTRIENT FLUX BETWEEN SEDIMENT AND WATER: A LABORATORY STUDY,
Goeteborg Univ. (Sweden). Dept. of Marine Botany.
K. Sundback, and W. Graneli.
Marine Ecology Progress Series MESEDT, Vol. 43, No. 1/2, p 63-69, March 24, 1988. 6 fig, 45 ref.

Descriptors: *Benthic flora, *Nutrients, *Solute transport, *Sediments, *Algae, *Marine biology, Microorganisms, Aquatic plants, Benthos, Flora, Interfaces, Sediment-water interfaces, Phosphorus, Nitrogen, Seawater, Light intensity, Chlorophyll A, Nitrates, Ammonium, Phosphates, Oxygen, Diatoms, Chrysophyta.

The importance of microphytobenthos as a regulator of the flux of inorganic phosphorus and nitrogen between sediment and water was investigated in a laboratory study. Sediment from a bay in Sweden was incubated in nutrient-enriched seawater during exposure to varying light quantities. Microphytobenthos growth was limited by both inorganic nutrients and light quantity. When exposed to no-light conditions, chlorophyll a content of the sediment decreased only slightly and remained at an almost constant level (50 to 55 mg/sq m) for several weeks, and increased rapidly when exposed to light. A relationship was observed between light quantity and the rate and direction of the flux of ammonium and phosphate, but not nitrate, between the sediment and overlying water. The indirect influence of the microphytobenthos on the nutrient flux, i.e., by changes in the oxygen concentration, seemed more important than the direct effect by uptake by the algae. When the amount of light was > or = 10 microE/sq m/s, the microbenthic activity (oxygen production and increased nutrient requirements) prevented the release of phosphate and ammonium from the sediment. (Author's abstract)
W89-01036

ACTIVE EMERGENCE OF MEIOFAUNA FROM INTERTIDAL SEDIMENT,
Biologische Anstalt Helgoland (Germany, F.R.)
W. Armonies.
Marine Ecology Progress Series MESEDT, Vol. 43, No. 1/2, p 151-159, March 24, 1988. 4 fig, 2 tab, 47 ref.

Descriptors: *Marine biology, *Benthic fauna, *Intertidal areas, *Sediments, *Behavior, *Migration, Aquatic life, Aquatic animals, Benthos, Fauna, Animal behavior, Water currents, Copepods, Ostracods, Crustaceans, Platyhelminthes, Polychaetes, Oligochaetes, Annelids, Mollusks, Ecology.

Laboratory experiments were conducted to test for active meiofaunal emergences from intertidal sediment in the absence of currents. Copepoda, Ostracoda, Platyhelminthes, and Polychaeta actively left submerged glass jars containing undisturbed sandy sediment. Ostracoda and juvenile Bivalvia moved to the sediment surface and climbed out of the glass jars while other taxa left the jars by swimming. In no case did Nematoda or Oligochaeta leave the sediment. During a single nocturnal high tide, 87% of Copepoda, 67% of Ostracoda, and 42% of Platyhelminthes may leave the sediment. Emigration rates are significantly smaller during diurnal high tides. Copepoda were randomly distributed in the water column 10 to 50 cm above the bottom and Platyhelminthes between 10 and 40 cm. There are specific differences in the emigration rates of platyhelminth taxa. Diatom-feeders, copepod-feeders, and unspecific predators emerged in significantly higher proportions than did nematode-feeders and bacteria-feeders. Results suggest high mobility and high transport rates of intertidal meiofauna above the sediment. (Author's abstract)
W89-01037

LARGE-SCALE AND LONG-TERM VARIATIONS IN THE ZOOPLANKTON COMMUNITY OF THE GULLMAR FJORD, SWEDEN, IN RELATION TO ADVECTIVE PROCESSES,
Kristenebergs Marinbiologiska Station, Fiskebackskil (Sweden).
O. Lindahl, and L. Hernroth.
Marine Ecology Progress Series MESEDT, Vol. 43, No. 1/2, p 161-171, March 24, 1988. 7 fig, 4 tab, 42 ref.

Descriptors: *Fjords, *Zooplankton, *Biomass, *Seasonal variation, *Water exchange, *Copepods, *Advection, Plankton, Aquatic animals, Sweden, Surface water, Deep water, Crustaceans, Ecology.

Since 1978, long-term variations in zooplankton biomass have been studied in relation to the hydrography of the Gullmar fjord, west coast of Sweden. The effects of water exchange processes on the zooplankton community were given special attention. During each autumn, extremely variable numbers of Calanus spp. (Stages CIV to V) were transported to the fjord by inflows of Skagerrak surface water. Once inside the fjord, Calanus spp. descended into the deep water, but were more or less completely washed out again by the annual renewal of deep water during winter or spring. An anomaly in the zooplankton biomass observed in 1982-84 was caused by a more than 10-fold increase in the abundance of Calanus. It was concluded that advective processes were the major factor regulating zooplankton biomass in the fjord. (Author's abstract)
W89-01038

DISPERSAL AND RECRUITMENT OF FIDDLER CRAB LARVAE IN THE DELAWARE RIVER ESTUARY,
Delaware Univ., Lewes. Coll. of Marine Studies.
C. E. Epifanio, K. T. Little, and P. M. Rowe.
Marine Ecology Progress Series MESEDT, Vol. 43, No. 1/2, p 181-188, March 24, 1988. 6 fig, 3 tab, 26 ref. NOAA Office of Sea Grant, Department of Commerce, Grant NA85AA-D-SG033 (Project NO. R/M-4).

Descriptors: *Migration, *Crabs, *Estuaries, *Larval growth stage, *Tidal marshes, *Marine biology, Crustaceans, Animal behavior, Environment, Estuarine environment, Delaware River Estuary, Growth stages, Adult growth stage, Marshes, Creeks, Bays, Habitats, Salinity, Model studies, Chemical properties, Behavior.

In spite of a semi-terrestrial adult habitat, fiddler crabs of the Middle Atlantic Bight show no adaptation for retaining larvae in tidal marsh creeks. Abundant data show that newly hatched zoeae are rapidly carried into primary estuaries. The present investigation shows that there is some retention of all zoeal stages within the estuary, but that substantial numbers of zoeae are carried to the adjacent continental shelf. Later zoeal stages are common deep in the water column at stations as far as 35 km from the bay mouth. Collections over 6 consecutive tidal cycles in a secondary estuary indicate that megalopae utilize flood tidal currents to augment their upstream migration to adult habitat. A conceptual model based on both field and laboratory data predicts that salinity is a gross filter separating populations of Uca minax and Uca pugnax, but that final selection of adult habitat is controlled by other factors. (Author's abstract)
W89-01039

INTERSPECIFIC, SEASONAL AND DIEL VARIATIONS IN ZOOPLANKTON TRYPSIN AND AMYLASE ACTIVITIES IN KOSTERFJORDEN, WESTERN SWEDEN,
Goeteborg Univ. (Sweden). Tjarno Marine Biological Lab.
U. Bamstedt.
Marine Ecology Progress Series MESEDT, Vol. 44, No. 1, p 15-24, April 21 1988. 4 fig, 6 tab, 47 ref.

Descriptors: *Enzymes, *Zooplankton, *Physiological ecology, *Seasonal variations, *Diurnal distribution, *Copepods, *Feeding rates, Ecology, Plankton, Aquatic animals, Aquatic life, Distribution, Sweden, Trophic level, Growth stages, Respiration, Marine biology, Crustaceans.

High interspecific variability in trypsin and amylase activities of boreal macrozooplankton species, prevailing during an 8 mo investigation, could not be explained by differences in trophic position of the species. A pronounced but delayed response to the spring phytoplankton bloom was recorded for herbivorous but not for carnivorous species. The 2 copepods Calanus finmarchicus and Metridia longa, having different life strategies, showed significantly different enzyme activity during most of the investigation. The non-feeding adult males of 2 carnivorous copepods showed a depressed trypsin activity but normal amylase activity compared with feeding developmental stages. The copepod Chiridius armatus from Kosterfjorden, as well as from the Norwegian west coast, always displayed exceptionally high trypsin activity. A diurnal rhythm in enzyme activity, significantly correlated with the feeding activity and respiration rate, was recorded for Stage V copepodites Calanus finmarchicus studied in late September. Results suggest that data on enzyme activities of mixed zooplankton samples cannot be used as a general indicator of zooplankton feeding levels. But for a given species the activities of digestive enzymes may reflect both long-term (seasonal) and short-term (diurnal) changes in feeding activities. (Author's abstract)
W89-01040

PELAGIC ECOSYSTEM MODEL SIMULATING PRODUCTION AND SEDIMENTATION OF BIOGENIC PARTICLES: ROLE OF SALPS AND COPEPODS,
Station Zoologique, Villefranche-sur-Mer (France).
V. Andersen, and P. Nival.
Marine Ecology Progress Series MESEDT, Vol. 44, No. 1, p 37-50, April 21, 1988. 8 fig, 6 tab, 64 ref. Centre National de la Recherche Scientifique Grant (CNRS)-U.A. 716.

Descriptors: *Model studies, *Marine biology, *Copepods, *Sedimentation, *Particulate matter, *Organic matter, Coasts, Crustaceans, Simulation, Phytoplankton, Aquatic plants, Plankton, Diatoms, Chrysophyta, Algae, Feces, Sediment samples, Biomass.

Production and sedimentation of biogenic particles were investigated by a depth-dependent model of a Mediterranean coastal pelagic ecosystem during spring. The model considers living and dead phytoplankton (chiefly diatoms) and its sedimentation,

2 herbivores, salps and copepods, and sedimentation of their fecal pellets and carcases. A sediment trap is assumed to be set up at 200 m depth. Results underline the major role played by fecal pellets and by both living and dead salps in vertical matter flux. Fecal pellets of salps and copepods constitute 65% of the material in the trap after a 40 d simulation period. Although salp and copepod biomasses are similar, the magnitude and composition of the particle flux are much more influenced by salps than by copepods: salp fecal pellets and carcases account for 72% of the maximum overall flux. The fluxes calculated by this model are in good agreement with those generally recorded in the field: at 200 m depth, up to 72.3 mg C/sq m/d and a mean of 44.7 mg C/sq m/d over 40 d. (Author's abstract)
W89-01041

MICRONUCLEUS TEST: EXAMPLES OF APPLICATION TO MARINE ECOLOGY,
Padua Univ. (Italy). Dept. of Biology.
For primary bibliographic entry see Field 5A.
W89-01042

USE OF FACTORIAL EXPERIMENTAL DESIGN TO EVALUATE HOW BIOTIC AND ABIOTIC FACTORS INFLUENCE CADMIUM ACCUMULATION IN THE UNICELLULAR ALGA DUNALIELLA BIOCULATA,
Paris-7 Univ. (France). Lab. de Cytophysiologie Vegetale et Toxicologie Cellulaire.
For primary bibliographic entry see Field 5B.
W89-01043

PATTERNS OF SULFATE REDUCTION AND THE SULFUR CYCLE IN A SOUTH CAROLINA SALT MARSH,
Maine Univ., Walpole. Ira C. Darling Center for Research, Teaching and Service.
For primary bibliographic entry see Field 2K.
W89-01046

DISCRIMINATION BETWEEN ALGAE AND ARTIFICIAL PARTICLES BY FRESHWATER AND MARINE COPEPODS,
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.). Dept. of Ecophysiology.
For primary bibliographic entry see Field 2H.
W89-01047

MARSH MANAGEMENT PLANS IN PRACTICE: DO THEY WORK IN COASTAL LOUISIANA, USA,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
J. H. Cowan, R. E. Turner, and D. R. Cahoon.
Environmental Management EMNGDC, Vol. 12, No. 1, p 37-52, 1988. 2 fig, 6 tab, 41 ref.

Descriptors: *Marshes, *Management planning, *Louisiana, *Wetlands, *State jurisdiction, Planning, Land management, Land resources, Legislation, Quality control, Reservoirs, Environmental impact statement, Productivity, Agriculture, Aquaculture, Structural engineering, Legal aspects, Ecology.

Louisiana's coastal wetlands represent 41% of the nation's total and are extensively managed for fish, fur, and waterfowl. Marsh management plans (MMPs) are currently used to avoid potential user conflicts and are believed to be the best management practice for specific management goals. MMPs are defined and their variety, history, impacts, and future are examined. A MMP is an organized written plan submitted to state and federal permitting agencies for approval and whose purpose is to regulate wetland habitat quantity and quality (control land loss and enhance productivity). MMPs are usually implemented by making structural modifications in the marsh, primarily by using a variety of water control structures in levees to impound or semi-impound managed areas. It appears that MMPs using impoundments are only marginally successful in achieving and often contradict management goals. Although 20% of coastal Louisiana may be in MMPs by the year 2000, conflict resolution of public and private goals is compromised by a surfeit of opinion and experience. Based on the interpretation of these results it is believed that the next phase of management should include scientific studies of actual impacts, utilization of post-construction monitoring data, inventory of existing MMPs, development of new techniques, and determination of cumulative impacts. (Author's abstract)
W89-01060

ONCE AND FUTURE EXPERIENCE OF THE CALIFORNIA COASTAL CONSERVANCY,
California State Coastal Conservancy, Oakland.
For primary bibliographic entry see Field 6E.
W89-01067

WETLAND PROJECTS OF THE CALIFORNIA STATE COASTAL CONSERVANCY: AN ASSESSMENT,
Zentner and Zentner, San Francisco, CA.
For primary bibliographic entry see Field 6E.
W89-01069

COASTAL MANAGEMENT ISSUES FOR THE MOUTH OF THE RIVER MURRAY, SOUTH AUSTRALIA,
South Australia Dept. of Environment and Planning, Adelaide.
For primary bibliographic entry see Field 6E.
W89-01072

SEDIMENTS IN THE ESTUARINE ENVIRONMENT OF THE TIGRIS/EUPHRATES DELTA; IRAQ; ARABIAN GULF,
Basrah Univ. (Iraq). Marine Science Centre.
S. A. Darmoian, and K. Lindqvist.
Geological Journal, Vol. 23, No. 1, p 15-37, March 1988. 11 fig, 5 tab, 35 ref.

Descriptors: *Sediments, *Deltas, *Estuaries, *Iraq, *Arabian Gulf, *Sedimentology, *Organic matter, *Salinity, *Minerals, Surface water, Quartz, Feldspar, Halite, Carbonates, Silt, Clays, Sand, Fluvial sediments, Mud flats, Calcite, Dolomite.

Studies on surface water characters of the estuarine environment of Iraq, northwestern Arabian Gulf, define three subdivisions of salinity; oligohaline, polyhaline, and euhaline. Textural analysis reveals that surface sediments covering the bottom are composed of six distinct classes: silty clay, clayey silt, sand-silt-clays, clayey sand, silty sand and sand. Five physiographic subdivisions were identified: fluvial-estuarine, tidal mud flats, sand bars, Abdallah-Shetana channel and submerged estuarine distributary channel and bar systems. The content of organic matter in the sediments ranges from 0.24-3.69% by weight. Carbonates, quartz, feldspar, and halite are the main mineral constituents of the non-clay grade sediments. Carbonates are present mainly as low-magnesium calcite followed by dolomite and high-magnesium calcite. Aragonite is present only in trace amounts. Both detrital and biogenic sources are suggested for low-magnesium calcite. A detrital source for dolomite and biogenic source for high-magnesium calcite and aragonite are proposed. (Author's abstract)
W89-01083

SEDIMENTARY ENVIRONMENTS AND FACIES OF THE SUBTROPICAL MGENI ESTUARY, SOUTHEAST AFRICA,
National Inst. for Water Research, Congella (South Africa). Natal Regional Lab.
J. G. Cooper.
Geological Journal, Vol. 23, No. 1, p 59-73, March 1988. 10 fig, 3 tab, 39 ref.

Descriptors: *Sediments, *Sedimentary structures, *Estuaries, *Subtropic zone, *Africa, Estuarine environment, Deltas, Channels, Erosion, Dunes, Flora, Fauna, Coastal waters.

The Mgeni Estuary is situated on the subtropical, mainly microtidal Natal coast. Modern sedimentary environments in the estuary comprise two groups. Barrier associated environments include inlet channel, inlet beachface, tidal delta, washover fans, transverse intertidal bars and aeolian dunes. Estuarine environments include subtidal channels, intertidal bars, back-barrier lagoon, tidal creek, tidal creek side-attached bars, creek mouth bar, mangrove fringe and supratidal mudflats. Each sedimentary facies is described in terms of grain size, sedimentary structures, and sedimentary processes. The distinctive flora and fauna play an important role in facies recognition. Vertical sequences produced by infilling of the estuary and subsequent coastal erosion are discussed. The facies are considered sufficiently distinct to warrant recognition in the geological record. (Author's abstract)
W89-01084

RELEASE OF MICRO-ALGAL PHOTOSYNTHATE AND ASSOCIATED BACTERIAL UPTAKE AND HETEROTROPHIC GROWTH,
University Coll. of Wales, Aberystwyth. Dept. of Botany and Microbiology.
For primary bibliographic entry see Field 2H.
W89-01187

RESTORATION OF WETLANDS UNDER SECTION 404 OF THE CLEAN WATER ACT: AN ANALYTICAL SYNTHESIS OF STATUTORY AND CASE LAW PRINCIPLES,
For primary bibliographic entry see Field 6E.
W89-01189

CHANGES IN THE ECOSYSTEM OF THE AZOV SEA IN RELATION TO ECONOMIC DEVELOPMENT IN THE BASIN,
Azovskii Nauchno-Issledovatel'skii Inst. Rybnogo Khozyaistva, Rostov-na-Donu (USSR).
For primary bibliographic entry see Field 6G.
W89-01192

COMMUNITY STRUCTURE OF ZOOPLANKTON IN EASTERN HUDSON BAY,
Arctic Biological Station, Ste. Anne de Bellevue (Quebec).
M. Rochet, and E. H. Grainger.
Canadian Journal of Zoology CJZOAG, Vol. 66, No. 7, p 1626-1630, July 1988. 4 fig, 4 tab, 27 ref.

Descriptors: *Coastal waters, *Species composition, *Zooplankton, *Hudson Bay, Biological samples, Ecological distribution, Ecosystems, Salinity, Water temperature, Larval growth stage, Water depth, Density stratification, Arctic zone, Canada.

Twenty-five zooplankton stations in eastern Hudson Bay were grouped into four geographical regions on the basis of salinity and temperature. One region, of high salinity and low temperature in deep water showed a preponderance of arctic zooplankton. The second, with moderate salinity, low temperature, and shallow depths, supported mainly meroplanktonic larvae. The third, less saline and warmer in the upper levels, supported a euryhaline fauna, and the shallower fourth region sustained a fauna with still-wider salinity tolerance. Strong pycnocline development supported a near-surface euryhaline fauna below which the arctic faunal element was concentrated in deeper water. Less-stratified water, where pycnocline development was slight or absent, inhibited establishment of a euryhaline fauna and permitted a greater near-surface presence of the arctic zooplankton. The major zoogeographic element in eastern Hudson Bay, and probably in most of the bay, is arctic, reflecting the continuity of this area with the primarily arctic waters of the Canadian archipelago and the surface of the Arctic Ocean. Carried cyclonically around the bay, the arctic fauna penetrates the eastern sector, especially north of the Belcher Islands. The euryhaline fauna indicates the influence of James Bay, mainly in the southeastern extremity of the bay. (Author's abstract)
W89-01232

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

FORMATION OF HYDROUS ZIRCONIUM (IV) OXIDE POLYELECTROLYTE MEMBRANES, I. POLY (ITACONIC ACID) AND POLY (ACRYLIC-CO-ITACONIC ACID),
Stellenbosch Univ. (South Africa). Inst. for Polymer Science.
A. J. Van Reenen, N. A. Dowler, and R. D. Sanderson.
Desalination DSLNAH, Vol. 69, No. 1, p 1-8, June 1988. 1 fig, 1 tab, 29 ref.

Descriptors: *Industrial wastewater, *Water reuse, *Heavy metals, *Wastewater treatment, *Reverse osmosis, *Membrane processes, Polymers, Chemical analysis, Hydrogen ion concentration, Zirconium.

The use of dynamically formed membranes in reverse osmosis to purify wastewater for reuse in industrial processes has led to a study of some new materials as components of these membranes. Poly(acrylic acid) (I), poly(itaconic acid) (II) and poly(acrylic acid-co-itaconic acid) (III) were synthesized. These polymers were used to dynamically form composite membranes with hydrous zirconium (IV) oxide. The membranes were formed on Millipore HA filters (rated 0.45 micrometers). The formation characteristics of zirconium (I), zirconoum (II) and zirconium (III) membranes were observed. The three different membranes were evaluated and compared after 24 h of use at pH 7, and at pH 8 and pH 9 for 1 hr at each pH. Comparison and evaluation was done in terms of the membranes' salt (NaNO3) rejection, flux and figures of merit. The zirconium (III) membranes show an interesting improvement in performance at pH values above neutral. (Author's abstract)
W89-01062

EXPERIMENTS ON SEAWATER DESALINATION BY MEMBRANE DISTILLATION,
Water Reuse Promotion Centre, Tokyo (Japan).
S. Kubota, K. Ohta, I. Hayano, M. Hirai, and K. Kikuchi.
Desalination DSLNAH, Vol. 69, No. 1, p 19-26, June 1988. 12 fig, 1 tab.

Descriptors: *Desalination, *Membrane processes, *Distillation, *Seawater, Water quality, Flow rates, Permeability, Temperature effects, Conductivity, Brines, Cooling water.

The membrane distillation (MD) process offers high quality product water, is simple and highly self-adjusting, and is easy to operate and maintain. However, the results of fundamental experiments with plate and frame type modules in a single-stage parallel stack indicate a heat efficiency of less than 50%. To develop a practical membrane distillation process, a multi-stage membrane distillation process and a suitable membrane module with high efficiency needs to be developed to make the heat efficiency of the whole system as high as possible. Heat efficiency, operating conditions and product water quality were examined using two kinds of modules of the plate and frame type with a capacity of 100-200 L/day. The heat efficiency of the modules was increased as the operating trmperature of the brine was raised. The product water quality should have been better than that indicated by the test results (electrical conductivity of 10 micro S/cm), because any contaminant of raw seawater other than volatile substances should be rejected perfectly by the membrane. Practical application of the MD process requires improvement in the heat efficiency of the module, reduction of heat loss and development of a multi-stage process similar to those used in existing desalination systems. (Stoehr-PTT)
W89-01063

COGENERATION POWER DESALINATION PLANTS,
Kuwait Univ., Safat. Dept. of Mechanical Engineering.
M. A. Darwish.
Desalination DSLNAH, Vol. 69, No. 1, p 27-46, June 1988. 5 fig, 6 tab, 8 ref.

Descriptors: *Desalination plants, *Cogeneration, *Powerplants, *Thermodynamics, Brines, Entropy, Steam, Heat transfer, Water temperature, Thermal power.

The use of fuel in producing both power and desalted water by a cogeneration power desalting plant was compared with that in separate desalting and power plants. The second law of thermodynamics efficiencies of a boiler driving a desalting plant separately, a boiler of a dual purpose plant, and a dual purpose plant as a whole were calculated. Typical reference desalting and steam power plants of were given to show their performance and fuel consumptions in both separate and combined arrangements. The available energy consumption and second law efficiency were used for rating the desalting plant and the dual purpose plant. These rating methods provided to be more realistic than other rating methods (i.e., performance ratio, gain ration for desalting plants and first law efficiency and utilization factor for dual purpose plants). It is concluded that the combination of the desalting plant to the steam powerplant offers savings in turbine and condenser sizes and slightly improves the power product ion process efficiency. (Stoerh-PTT)
W89-01064

RO DESALINATION IN NORTHWEST CHINA,
Lanzhou Inst. of Membrane Science and Tech. (China).
W. Ying.
Desalination DSLNAH, Vol. 69, No. 1, p 57-59, June 1988. 1 fig, 15 ref.

Descriptors: *Desalination, *China, *Reverse osmosis, Membrane processes, Brackish water, Rainfall distribution, Water treatment, Ultrafiltration.

The brackish water desalination problem in northwest China is reviewed, and current efforts to develop lower cost reverse osmosis equipment for use in such remote locations are described. The aim of the Institute of Membrane Science and Technology is to increase the efficiency of the equipment used in plant construction. In addition to brackish water desalination, other areas of research performed by the Institute include ultrafiltration, microfiltration, gas separation, and liquid membranes. (Author's abstract)
W89-01065

PRELIMINARY PLAN FOR MEMBRANE DESALINATION IN CHINA,
National Bureau of Oceanography, Hangzhau (China). Second Inst. of Oceanography.
G. Conjie.
Desalination DSLNAH, Vol. 69, No. 1, p 61-62, June 1988.

Descriptors: *Membrane processes, *Desalination, *China, *Water treatment, *Wastewater treatment, *Reverse osmosis, Boiler water, Ultrafiltration, Brackish water.

Membrane technology has been playing an increasing role in water treatment in China. This paper summarizes the topics discussed at the Seawater Desalination and Water Reuse Society's meeting on May 8, 1987. The society's recommendations include one or two demonstration plants for ultrapure water production, one plant for boiler feed water production, and one plant for brackish water desalination. The role of the computer in system design and plant control is addressed. The focus of fundamental research is the selection of new membrane materials. (E. Stoehr-PTT)
W89-01066

3B. Water Yield Improvement

WATER-MANAGEMENT SIGNIFICANCE OF THE MOSCOW CANAL,
O. S. Tsvirin'ko.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 6, p 315-322, December 1987. 3 fig, 4 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 6, p 7-11, June 1987.

Descriptors: *Canals, *Water supply development, *Hydroelectric plants, *Moscow Canal, *Water management, Navigation, Water use, History, Metropolitan water management, Soviet Union, Navigation canals, Water resouces development.

The complex of hydraulic structures of the Moscow Canal is unique in composition and tasks being performed. The canal's route intersects a multitude of rivers, highways, railroads, and other lines of communication; and seven hydroelectric stations operate in the canal system. The maximum annual electric power production of the Moscow Canal was reached in 1953 and was 278 million kWh. After reallocation of water resources for other uses, the current capacity is still over 200 million kWh/yr. Water management of the Moscow Canal includes not only the Canal, but also water bodies of the Upper Volga and its tributaries. It is most convenient to trace the water-management significance of the Moscow Canal by examining components of its water balance in dynamics during 50 years of operation. The technical design of the Moscow Canal provided for delivery of the Moscow River as a source of water to the city at 9 cu m/sec. At present the delivery volume has been exceeded by more than 3 times. With the startup of delivery from a fifth reservoir in the 1970s water supply demand has been satisfied. An increase of the capacity of the Moscow Canal and delivery of its pumping stations is dictated by the continuous increase of the water supply needs of the capital. After completing current works and using new water sources, the role of the canal in the water supply of Moscow will increase. (VerNooy-PTT)
W89-00050

SECONDARY ICE NUCLEUS GENERATION BY SILVER IODIDE APPLIED TO THE GROUND,
Commonwealth Scientific and Industrial Research Organization, Aspendale (Australia). Div. of Atmospheric Research.
E. K. Bigg.
Journal of Applied Meteorology JAMOAX, Vol. 27, No. 4, p 453-457, April 1988. 2 fig, 5 ref.

Descriptors: *Cloud seeding, *Ice formation, *Silver iodide, *Monitoring, *Weather modification, Filters, Membrane filters, Precipitation, New South Wales.

Ice nuclei were monitored using the membrane filter technique at eight sites in New South Wales around the 17-km perimeter of a rough circle and at one site in a 40-ha wheat field within the circle. The wheat field was then sprayed in fine weather with 2,000 l of an aqueous colloid, made by rapidly diluting a stock cloud seeding solution of 1.7 kg of silver iodide in 3 l of acetone containing 340 gm of sodium iodide. From 13 to 21 h later, there was a large increase in ice nucleus concentrations at sites downwind from the sprayed area during that period. It took several days for concentrations to subside to the background level established over the preceding 5 months. At intervals of 10 days, high ratios of concentrations in the sprayed area relative to those in the control were repeated out to the 40th day, soon after which the experiment was terminated. This behavior suggests that secondary ice nuclei released into the air following the addition of cloud seeding chemicals to the ground could have been responsible for apparent persistent effects in earlier cloud seeding experiments. (Author's abstract)
W89-00088

WINTER DIURNAL TRENDS OF SIERRA NEVADA SUPERCOOLED LIQUID WATER AND PRECIPITATION,
Electronic Techniques, Inc., Auburn, CA.
T. F. Lee.
Journal of Applied Meteorology JAMOAX, Vol.

27, No. 4, p 458-472, April 1988. 13 fig, 2 tab, 16 ref. Bureau of Reclamation, Department of the Interior, Contract 4-CR-81-03860.

Descriptors: *Supercooling, *Precipitation, *Climatology, *Clouds, *Atmosphere water, Distribution, Diurnal distribution, Seasonal variation, Convection, Freezing, Temperature, Condensation, Dewpoint, Sierra Nevada, Atmospheric physics.

Ten-year climatologies from the Sierra Cooperative Pilot Project (SCPP) show diurnal variations of clouds, precipitation, supercooled liquid water, stability, and temperature. Diurnal variations were generally more pronounced in March than in January and February. March, in particular, developed a pronounced maximum of afternoon convection due to strong modulation of spring air masses by surface heating. Supercooled liquid water was most abundant between midnight and dawn and least abundant at midday; this trend grew stronger from January through March. Two effects help to explain the diurnal trend of supercooled liquid water at Squaw Peak, a mountain top location. First, when the freezing level stayed above Squaw Peak during the day but descended below it at night, water cloud was only supercooled at the site at night. Second, low-level water cloud often dissipated as surface heating raised the temperature of overlying air above its dewpoint; water cloud formed at night through a reverse process. (Author's abstract)
W89-00089

PERSISTENT EFFECTS OF CLOUD SEEDING WITH SILVER IODIDE,
Commonwealth Scientific and Industrial Research Organization, Aspendale (Australia). Div. of Atmospheric Research.
E. K. Bigg, and E. Turton.
Journal of Applied Meteorology JAMOAX, Vol. 27, No. 5, p 503-514, May 1988. 5 fig, 1 tab, 13 ref.

Descriptors: *Cloud seeding, *Silver iodide, *Weather modification, *Artificial precipitation, Statistical analysis, Australia, Precipitation, Ice.

A statistical examination of precipitation records in and near areas where cloud seeding experiments have taken place in Australia strongly suggests the delayed effects of seeding. The most conspicuous effect is an increase in precipitation 1 to 3 weeks after a seeded day, which would have caused the conventional statistical estimates of success to have been misleading. Through comparison with earlier findings and some observations of prolonged increases in ice nucleus concentrations following the application of silver iodide to the ground, it is argued that secondary ice nuclei are involved in the persistent effects of seeding. If this is so, then they must have been more effective in enhancing precipitation than the silver iodide itself; this leads to the possibility that there may be better ways of stimulating precipitation than those used so far. (Author's abstract)
W89-00091

OPTIMIZATION MODEL FOR SCREENING MULTIPURPOSE RESERVOIR SYSTEMS,
Utah Univ., Salt Lake City. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W89-00703

IMPROVING CANAL WATER DELIVERIES WITH AUXILIARY STORAGE,
Central Marine Fisheries Research Inst., Calcutta (India).
A. Mishra, and N. K. Tyagi.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 114, No. 3, p 535-546, August 1988. 6 fig, 5 tab, 9 ref, append.

Descriptors: *Irrigation efficiency, *Water supply, *Water distribution, *Water yield improvement, *Irrigation canals, *Controlled storage, *Water delivery, *Water demand, *Water conservation, *India, *Cropland, Farms, Agriculture, Crop production, Climatology, Pumped storage, Economic aspects.

The temporal distribution of an irrigation water delivery and demand ratio was used to analyze the performance of an irrigation water delivery system in the Bhakra Canal Command in India. A high degree of mismatch was found to exist between water demand and supply. Based on historical canal deliveries, agroclimatic data, and crop production with dated inputs, yields of wheat, a major irrigated crop of the region, were simulated over a period of 20 years. It was found that crop production was constrained by 34% (20-year average) due to unfavorable water delivery characteristics. An evaluation was made of introducing auxiliary storage at the farm outlet level to modify the water delivery schedule. Based on the increase in crop yield due to improved distribution of water supply delivery and the cost of auxiliary storage (including the cost of pumping), it was found that auxiliary storage could be used to considerable economic advantage. (Author's abstract)
W89-00758

ENHANCEMENT OF RUNOFF FROM A SMALL WATERSHED BY CLOUD SEEDING,
Ministry of Agriculture, Jerusalem (Israel). Hydrological Service.
A. Ben-Zvi.
Journal of Hydrology JHYDA7, Vol. 101, No. 1-4, p 291-303, June 30, 1988. 2 fig, 5 tab, 8 ref.

Descriptors: *Water yield improvement, *Cloud seeding, *Small watersheds, Israel, Rainfall- runoff relationships, Spatial distribution, Runoff.

Daily volumes of runoff, from a small watershed, are compared, with respect to daily depths of precipitation, under randomly allocated cloud seeding. Enhancement is found with respect to rainfalls at the control and at the target area. The effect is evident by doubling the number of runoff days, by doubling the ratio to the volume of the precipitation, and by heightening the regression line for nonleading days in runoff sequences. With respect to the rainfall at the control, this heightening is about 40% of the mean volume per runoff day. The generation of the runoff is governed by the abstractions which consume 98% of the precipitated waters. The seasonal abstractions are distributed between an initial depth of 230 mm, a continuing rate of 3 mm/day on days between runoff events, and around 95% of the precipitation depth on days when runoff occurs. The runoff occurs in spells of consecutive days. For nonleading days, and when no snowmelt component is present, daily volume of the runoff is correlated with the daily depth of the rainfall on the watershed. Higher volumes are found in presence of a snowmelt runoff, and lower volumes are found for the leading days of the runoff spells. High rates of enhancement are found for the intense fraction of the rainfall, for the Eastern sector of the watershed and for the later portion of the rainy season. These nonuniformities in the rainfall enhancement seem to be the cause for the enhancement of the runoff with respect to the precipitation on the watershed. (Author's abstract)
W89-01212

3C. Use Of Water Of Impaired Quality

TISZA WATER, AS IRRIGATION WATER, POLLUTED WITH VARIOUS COMPOUNDS,
Jozsef Attila Univ., Szeged (Hungary). Dept. of Biophysics.
A. Kovacs, and M. Meszaros.
Tiscia (Szeged), Vol. 21, p 25-29, 1986. 6 tab.

Descriptors: *Water pollution effects, *Hungary, *Toxicity, *Irrigation water, *Tisza River, *Herbicides, *Sodium chloride, *Plant growth, Chlorobromurons, Wastewater, Catchment areas, Seedlings, Germination, Tissue analysis, Corn, Melon, Bean, Enzymes, Plant physiology, Disinfectants, Maloran.

Water-pollutant compounds that washed into the water system of the Lower Tisza region (Hungary) were studied with regard to their effect on plants. The experiments were repeated 3-5 times and were performed on muskmelon, hybrid maize and horse bean plants using both preemergent and postemergent treatment with the following compound solutions: (1) 2 ml herbicide mixture (brominephenoxime and terbutylazime and glyphosate), (2) 0.5 g chlorobromurone, (3) 1 g sodium chloride in 1 l tap water, (4) 0.5 ml inoxane germicide in sewage. Studies were performed on growth, dry matter accumulation, ascorbic acid content, total soluble protein amount, development of peroxidase enzyme activity, total phenol amount as well as the changes in RNA values. In general the effects of the treatments were slight or undetectable on all plants. an exception was horse bean, which was adversely affected by chlorbromurone. (Miller-PTT)
W89-00145

TESTING THE SECONDARY TREATMENT OF EFFLUENTS FROM THE 'POLICE' CHEMICAL PLANT IN CARP PONDS,
Akademia Rolnicza w Szczecinie (Poland). Dept. of Hydrobiology.
For primary bibliographic entry see Field 5D.
W89-00255

UPTAKE AND DISTRIBUTION OF COPPER SULPHATE AND ITS EFFECT ON THE RESPIRATION RATE OF THE HEMOCYANIN-PRODUCING FRESHWATER SNAIL LYMNAEA NATALENSIS,
Potchefstroom Univ. for C.H.E. (South Africa). Dept. of Zoology.
For primary bibliographic entry see Field 5G.
W89-01155

POSSIBILITY OF USING RADIOACTIVELY POLLUTED WATERBODIES FOR FISH CULTURE,
Akademiya Nauk SSSR, Moscow. Inst. of General Genetics.
V. A. Shevchenko, V. L. Pechkurenkov, E. A. Federov, S. P. Peshkov, and G. L. Pokrovskaya.
Journal of Ichthyology JITHA2, Vol. 26, No. 4, p 113-122, 1986. 2 tab. 54 ref. Originally published in Voprosy Ikhtiologii, No. 3, 1986, pp 494-503.

Descriptors: *Impaired water use, *Radioactive wastes, *Radioactivity effects, *Fisheries, Cooling ponds, Nuclear energy, Reservoirs, Fish stocking, Water pollution, Genetic damage, Genetic load, Adaptation.

The use of radioactively polluted waterbodies to maintain brood stocks of spawners of valuable fish species is discussed. The development of nuclear energy presupposes creation of freshwater reservoirs of two types: (1) cooling ponds of atomic power plants whose radioactive pollution should not exceed the maximum permissible concentrations, and (2) the settling ponds in the radiochemical industry in which the radioactive pollution would be higher than the maximum permissible concentrations. The ultimate problem is accumulation of genetic load by the population during their maintenance in the radioactively polluted waterbodies. Based on a review of published reports as well as a morphometric analysis of carp in a pond where the dose rate is 0.5 rad/day, it can be concluded that the radioactively polluted reservoirs should be used for maintaining breeding stocks of valuable fish species and other hydrobionts. Even if dose rates to 0.5 rad/day increase genetic load, the increase is so insignificant that fish populations can readily adapt. (Miller-PTT)
W89-01193

3D. Conservation In Domestic and Municipal Use

DEVELOPING AND ASSESSING A MODEL OF RESIDENTIAL WATER CONSERVATION,
California Univ., Berkeley. Dept. of Social Administrative Health Services.
W. H. Bruvold, and B. R. Smith.
Water Resources Bulletin WARBAQ, Vol. 24, No. 3, p 661-669, June 1988. 1 fig, 4 tab, 15 ref.

Descriptors: *Domestic water, *Water conservation, *Planning, *Model studies, *Consumptive use, Water rates, Time series analysis, Literature review.

Relevant literature was reviewed from which a model of residential water conservation was developed. Four residential conservation program interventions were posited: (1) public education, (2) pricing variables, (3) water use restrictions, and (4) building code requirements. Four exogenous variables affecting residential water use were also posited: temperature, rainfall, household income, and household size. The impact of these eight variables on residential per capita daily use was assessed by cross sectional and time series analysis. Study results generally supported the proposed model, with leas consistent support obtained for pricing variables and conservation beliefs. The paper concludes with the hypothesis that an inclining block rate structure coupled with an informational program designed to inform consumers of their consumption under each block will have a synergistic impact. (Author's abstract)
W89-00881

CHANGING MEANING OF WATER CONSERVATION IN THE WEST,
Chicago-Kent Coll. of Law, IL.
For primary bibliographic entry see Field 6E.
W89-01269

3E. Conservation In Industry

FORMATION OF HYDROUS ZIRCONIUM (IV) OXIDE POLYELECTROLYTE MEMBRANES, I. POLY (ITACONIC ACID) AND POLY (ACRYLIC-CO-ITACONIC ACID),
Stellenbosch Univ. (South Africa). Inst. for Polymer Science.
For primary bibliographic entry see Field 3A.
W89-01062

3F. Conservation In Agriculture

IMPLICATIONS OF PUBLIC OWNERSHIP OF IRRIGATION CANAL SYSTEMS IN THE TEXAS RICE BELT: IMPACTS ON WATER USE AND WATER PRICE,
Texas A and M Univ., College Station. Dept. of Agricultural Economics and Rural Sociology.
For primary bibliographic entry see Field 6E.
W89-00460

HORIZONTAL INFILTRATION OF WATER IN SOIL COLUMNS AS AFFECTED BY A GEL-FORMING CONDITIONER,
King Saud Univ., Riyadh (Saudi Arabia). Dept. of Soil Science.
For primary bibliographic entry see Field 2G.
W89-00741

WATER MANAGEMENT FOR LOWLAND RICE IRRIGATION,
Moratuwa Univ. (Sri Lanka). Dept. of Civil Engineering.
F. Z. Siddeek, T. A. Dillaha, and G. V. Loganathan.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 114, No. 3, p 407-423, August 1988. 7 fig, 3 tab, 14 ref, append.

Descriptors: *Irrigation, *Irrigation requirements, *Irrigation efficiency, *Water management, *Stochastic process, *Rice, *Agricultural hydrology, Water level, Evaporation, Rainfall, Cultivated lands, Rainfall-runoff relationships, Statistical studies, Sri Lanka, Water table fluctuations.

A procedure has been developed to increase irrigation efficiency by estimating probabilistic irrigation requirements for lowland rice cultivation. The procedure uses a water balance equation with random components to maintain minimum desired water levels in paddy fields at the end of each irrigation period. The procedure estimates weekly pan evaporation and rainfall at different probability levels, which are then used to estimate weekly irrigation requirements through the water balance relationship. The method has been applied to the Kalawewa irrigation scheme in Sri Lanka. Different statistical transformations were used to normalize observed weekly rainfall and evaporation data and to describe their variations. The power transformation was best able to transform the weekly data to normality. Comparison of the use of the model and current system practices shows that a significant amount of water can be saved even when the system is operated at high probability levels. (Author's abstract)
W89-00750

IMPROVING CANAL WATER DELIVERIES WITH AUXILIARY STORAGE,
Central Marine Fisheries Research Inst., Calcutta (India).
For primary bibliographic entry see Field 3B.
W89-00758

O AND M SPENDING LEVELS IN THIRD WORLD IRRIGATION SYSTEMS: EXPLORING ECONOMIC ALTERNATIVES,
P. F. M. McLoughlin.
Water Resources Bulletin WARBAQ, Vol. 24, No. 3, p 599-607, June 1988.

Descriptors: *Irrigation operation, *Economic aspects, *Alternative drilling, *Operating costs, *Maintenance costs, *Third World, Economic justification, Cost-benefit analysis, Management planning, Rehabilitation.

Third World irrigation and drainage systems have experienced major declines recently in both capability and performance. this is due initially to working them well beyond their design capacities; scouring, sedimentation, and overtopping result. Chronic operations and maintenance underfunding then adds heavily to this worsening malaise. International donors have assisted irrigation departments with rehabilitation projects and programs to improve effectiveness on a grand (billions of dollars) scale. Despite their historical propensity to examine, program economic justifications, the donors apparently have glossed over two basic analytic elements for (a) more spending on operations and maintenance as distinct from an equivalent spending on other means to provide farmers with a cubic meter of water; and (b) different levels of operations and maintenance spending on canals and drains. Surely those different levels provide differing benefits, in total, and at the margin. It needs to be determined which level is most economic. This paper identifies these analytical issues, posits methodologies key to an operations and maintenance spending level analysis, and discusses the information base. Particular attention is paid to identifying relevant costs and benefits, and to suggesting supplementary criteria for operations and maintenance spending level selection. (Author's abstract)
W89-00874

CHANGING MEANING OF WATER CONSERVATION IN THE WEST,
Chicago-Kent Coll. of Law, IL.
For primary bibliographic entry see Field 6E.
W89-01269

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

WATER-MANAGEMENT SIGNIFICANCE OF THE MOSCOW CANAL,
For primary bibliographic entry see Field 3B.
W89-00050

POWER FACILITIES OF THE MOSCOW CANAL,
For primary bibliographic entry see Field 8C.
W89-00053

HYDRAULIC TESTS FOR RECONSTRUCTING THE PUMPING STATIONS ON THE MOSCOW CANAL,
For primary bibliographic entry see Field 8C.
W89-00055

EFFECT OF GIBBERELLIC ACID AND 2,4-D ON WATER HYACINTHS,
Florida Univ., Gainesville. Center for Aquatic Weeds.
J. C. Joyce, and W. T. Haller.
Aquatic Botany AQBODS, Vol. 23, No. 2, p 119-125, November 1985. 2 fig, 2 tab, 11 ref. Department of Agriculture ARS Cooperative Agreement 58-7B30-0-177.

Descriptors: *Aquatic weed control, *Herbicides, *Water hyacinth, Regression analysis, Synergistic effects, Gibberellic acid, 2,4-D, Plant growth substances.

Combinations of Gibberellic Acid (GA3) and 2,4-dichlorophenoxyacetic acid (2,4-D) were evaluated to determine if GA3 increased the effectiveness of 2,4-D on water hyacinths (Eichhornia crassipes) under field conditions. Bulbous-leaved water hyacinths were grown outdoors in north Florida in 70-l containers during the 1980-1982 growing seasons with combinations of GA3 at 0, 23.5, 47.0, 94.0, and 188 g/ha and 2,4-D at 0, 0.28, 0.56, 1.12, and 2.24 kg/ha. Significant increases in the effectiveness of 2,4-D in combination with GA3 were observed at lower rates of 2,4-D. However, these increases appeared to be additive since regression analysis revealed no significant interaction or synergism between GA3 and 2,4-D at any level. (Author's abstract)
W89-00105

EQUATIONS RELATING GROWTH AND UPTAKE OF NITROGEN BY SALVINIA MOLESTA TO TEMPERATURE AND THE AVAILABILITY OF NITROGEN,
Commonwealth Scientific and Industrial Research Organization, Indooroopilly (Australia). Long Pocket Labs.
For primary bibliographic entry see Field 2H.
W89-00111

NITROGEN, PHOSPHORUS AND POTASSIUM IN SALVINIA MOLESTA MITCHELL IN THE FIELD: EFFECTS OF WEATHER, INSECT DAMAGE, FERTILIZERS AND AGE,
Commonwealth Scientific and Industrial Research Organization, Indooroopilly (Australia). Div. of Entomology.
For primary bibliographic entry see Field 2H.
W89-00113

EFFECT OF SEVERAL METHODS OF AQUATIC PLANT CONTROL ON TWO BILHARZIA-BEARING SNAIL SPECIES,
C. P. van Schayck.
Aquatic Botany AQBODS, Vol. 24, No. 3, p 303-309, June 1986. 3 tab, 19 ref.

Descriptors: *Aquatic plants, *Aquatic weed control, *Irrigation canals, *Parasites, *Snails, Biocontrol, Grass carp, Food habits, Herbicides, Aquatic habitats, Animal populations, Spawning, Predation, Egypt.

Four control methods for aquatic plants (manual, chemical, mechanical, and biological) were compared in the period from March-July 1982 in the canals of the Mansuriya irrigation district in Egypt. Grass carp (Ctenopharyngodon idella) was used as a biological control agent. Chemical control was effected by means of the herbicide acrolein (2-propanol), and a dragline was used for mechanical control. In biologically-controlled waterways, the number of the two vectors of bilharzia, the snails Biomphalaria alexandrina and Bulinus truncatus, was significantly lower (36 and 64%, respectively)

than in waterways with one of the other methods of aquatic plant control. Biological control resulted in the lowest total plant coverage in the snails' habitat. Moreover, the number of snails per unit of vegetation appeared to be lowest in biologically-controlled plots. The reduction of the snail population in waterways with biological control may be due to the fact that grass carp feed on the leaves of macrophytes on which snail egg masses are deposited. This study revealed that the snail habitat preference and the grass carp feeding preference coincide to a certain extent. Increased predation by omnivorous fish in biologically-controlled canals may play an additional role. (Author's abstract)
W89-00117

EXPERIENCES WITH THE ASSESSMENT OF THE RESIDUAL WATER FLOW IN REGULATED WATER COURSES IN THE SALZBURG REGION (ERFAHRUNGEN BEI DER BEURTEILUNG DER RESTWASSERFUHRUNG VON AUSLEITUNGSSTRECKEN IM LAND SALZBURG),
Amt der Salzburger Landesregierung (Austria). Unterabteilung Wasserbau.
P. Jager.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 68, No. 2, p 219-248, December 1985. 5 fig, 43 ref. English summary.

Descriptors: *Water use, *Streamflow, *Hydroelectric plants, *Diversion, *Ecological effects, Channel flow, River flow, Regulated flow, Salzburg, Switzerland, Bavaria.

Problems arising from diminished water flow when water is diverted from streams and rivers to provide hydroelectric power are discussed. The ways in which the governments of Salzburg, Switzerland and Bavaria have tackled these problems are compared. When regulating the water regime, attempts have been made to maintain the original characteristics of the stream so that the organisms that existed under the original natural conditions can continue to exist. Examination of the benthic epiphyton of residual water stretches of mountain streams with low substrate porosity show an ecological succession with four distinct stages depending on the amount of water withdrawn. A dynamic, uantifying model, which compares the sampling stations according to the dynamics of the stream flow events, is the most suitable method to evaluate the ecological succession. (Sand-PTT)
W89-00164

RIVER IMPROVEMENT PLANNING FOR FLOOD PROTECTION IN THE KISO RIVER BASIN UNTIL THE MEIJI ERA, (IN JAPANESE),
Nagoya Inst. of Tech. (Japan). Faculty of Technology.
M. Nagao.
Journal of Geography, Vol. 97, No. 2, p 80-90, 1988. 3 fig, 3 tab, 16 ref. English summary.

Descriptors: *Kiso River Basin, *Japan, *Flood protection, *Flood control, *Rivers, History, River improvement, Social impact, Economic impact, Nagara River, Ibo River, Deltas.

The Kiso River basin covers one of the greatest and most active areas in Japan in both a social and economic sense. The basin has three main streams: the Kiso, the Nagara and the Ibi River. Historically, these streams have had connection to each other through many tributaries, and have had an intimate relation by causing submersion damage from one stream to the others. Division of these three river channels had been considered as a master counterplan for mitigating flood damage. This paper describes the historical and hydrological circumstances of the counterplan in the Kiso River Basin until the Meiji River Improvement in 1870. It is known that human activity taken for river improvement has an unexpected influence on geographical, hydrological and social activities in a river basin. This interaction between rivers and human society under various governmental regimes is also explained from a historical viewpoint. (Author's abstract)
W89-00204

INHABITANTS' LIFE IN THE LOWLAND OF THE KISO, NAGARA AND IBI RIVERS, (IN JAPANESE),
Tokai Univ., Hiratsuka (Japan).
M. Ando.
Journal of Geography, Vol. 97, No. 2, p 91-106, 1988. 5 fig, 2 tab, 20 ref. English summary.

Descriptors: *Kiso River Basin, *History, *Japan, *Flood control, *Flood protection, *Rivers, Dikes, Embankments, Flood damage, Rice, Crop production, Social impact, Economic impact, Nagara River, Ibi River, Deltas.

In the lowland of the Kiso, Nagara and Ibi Rivers, the inhabitants constructed embankments around the villages and arable land for flood control. The flood control community is called Waja in Japanese. People have long dwelled in the Waja region and a part of the dike had been built in ancient times. It was only in the 17th century that the main parts of the Waja embankment were established for the first time. The construction of the Waja has increased since then. When a Waja was established, earth and sand have accumulated (Author's abstract)
W89-00205

MULTICRITERION STORMWATER MANAGEMENT METHODS,
Maryland Univ., College Park. Dept. of Civil Engineering.
R. H. McCuen, and G. E. Moglen.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 114, No. 4, p 414-431, July 1988. 10 fig, 11 ref, append.

Descriptors: *Storm runoff, *Flood control, *Urbanization, *Water management, *Flood peak, *Erosion control, Channel erosion, Model studies, Bed load, Flood discharge, Storm water, Runoff, Urban hydrology.

Both theory and experience indicate that, while detention basins designed to control peak discharge are effective in controlling peak rates, the basins are ineffective in controlling the degradation of erodible channels downstream of the basin. The increase in runoff volumes that accompanies land development causes greater rates of channel degradation because of the increased duration of high in-bank flow rates. While planning and design procedures are available for peak discharge control, there has been a need for similar methods for the control of channel erosion and water quality. The adoption of a policy that includes bed-material load as a criterion requires the selection of a bed-material load estimation method, or model. Both simple and complex models are available. The Goncharov, Shields, Meyer-Peter and Muller, and Schoklitsch methods are examples of simple models. The HEC-6 program is an example of the more complex type. It seems reasonable that the simple models are appropriate where the interest is a before-versus-after comparison and the synthetic design storm approach is used. Complex models are appropriate for other types of problems such as where measured bed-material load data are available for calibration of the sediment rating curve or where the depth of scour at various points in a single cross section must be evaluated. Almost all of the early stormwater management policies used the criteria that the T-year peak discharge after development could not exceed the T-year peak discharge for the before-development conditions. While the specific values for T varied from one location to another, the same return period was usually used in assessing the peak discharges for the two development conditions. Some localities found that the control of the flood runoff, when using the same return period for the before- and after-development conditions, was ineffective, which led to policies in which the return period for the after-development condition was larger than that for the before-development condition. It appears that some of these policies may be the result of using peak discharge as the criterion when another criterion, such as bed-material load, may have been more appropriate. (Lantz-PTT)
W89-00302

APPLICATION OF PRINCIPAL COMPONENT ANALYSIS TO LONG-TERM RESERVOIR MANAGEMENT,
Quebec Univ., Montreal. Ecole de Technologie Superieure.
For primary bibliographic entry see Field 6A.
W89-00698

OPTIMIZATION MODEL FOR SCREENING MULTIPURPOSE RESERVOIR SYSTEMS,
Utah Univ., Salt Lake City. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W89-00703

SUBSURFACE DRAINAGE PEAK FLOWS IN SHALLOW SOIL,
Centre National du Machinisme Agricole, du Genie Rural, des Eaux et des Forets, Antony (France). Div. Drainage et Assainissement Agricoles.
B. Lesaffre, and D. Zimmer.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 114, No. 3, p 387-406, August 1988. 12 fig, 1 tab, 27 ref.

Descriptors: *Infiltration, *Subsurface drainage, *Soil water, *Water level fluctuations, Loam, Wetlands, Model studies, Rainfall-runoff relationships, Water level, Water table rise, Hydraulic gradient.

The subsurface drainage operation of shallow soils is characterized by sudden and brief peak flows followed by long-lasting tail recessions. A field experiment was conducted on a seasonally waterlogged, shallow loamy soil in Arrou, France, under temperate climate. Rainfall and drainage discharge were recorded on an hourly basis, as well as water tension profiles and water-table levels at different distances from the trench. Observed peak flows are related to sudden increases in the horizontal hydraulic gradients near the trench and to the stability of the water-table shape. Using these results and extending Boussinesq's usual transient-state approach, SIDRA, a theoretical model in which soil vertical heterogeneity is taken into account, has been elaborated and applied to simulate by finite differences hourly water-table levels and drain flow rates. The paper compares observed and measured values of the winters of both 1980-81 and 1985-86. (Author's abstract)
W89-00749

WATER MANAGEMENT FOR LOWLAND RICE IRRIGATION,
Moratuwa Univ. (Sri Lanka). Dept. of Civil Engineering.
For primary bibliographic entry see Field 3F.
W89-00750

FLOW SIMULATION USING CHANNEL NETWORK MODEL,
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Water Resources and Environment Div.
For primary bibliographic entry see Field 7B.
W89-00751

EVALUATING PEAT-MINING HYDROLOGY USING DRAINMOD,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 4C.
W89-00755

O AND M SPENDING LEVELS IN THIRD WORLD IRRIGATION SYSTEMS: EXPLORING ECONOMIC ALTERNATIVES,
For primary bibliographic entry see Field 3F.
W89-00874

ALTERNATIVE STRATEGIES FOR STORMWATER DETENTION,
Syracuse Univ., NY. Dept. of Civil Engineering.
S. J. Nix, and T.-K. Tsay.

Water Resources Bulletin WARBAQ, Vol. 24, No. 3, p 609-614, June 1988. 8 fig, 1 tab, 14 ref.

Descriptors: *Alternative planning, *Storm runoff, *Simulation analysis, *Detention reservoirs, Urban runoff, Diversion, Discharge hydrographs, Flood peak.

In a simulation experiment, stormwater flows are partially diverted, at various levels, to a detention basin in order to compare the recombined (i.e., undiverted flows and basin discharges) hydrograph to the response of the traditional, in-line design. The use of off-line detention basins is shown to be an effective technique for levels with lower storage requirements. In addition, the discharge hydrographs produced by off-line detention are significantly different from those produced by the traditional design and may be more suited to certain stormwater management situations. Since the study was simply a simulation exercise, further study is certainly warranted. Nevertheless, the flexibility demonstrated here should encourage the use of more innovative designs that allow detention systems to meet local and regional needs. (Author's abstract)
W89-00875

GENERALIZED METHOD OF MOMENTS APPLIED TO LP3 DISTRIBUTION,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
For primary bibliographic entry see Field 2E.
W89-00901

REGULATED RIVERS IN THE UNITED KINGDOM,
Loughborough Univ. of Technology (England). Dept. of Geography.
G. E. Petts.
Regulated Rivers Research and Management RRRMEP, Vol. 2, No. 3, p 201-220, July-August 1988. 6 fig, 4 tab, 73 ref.

Descriptors: *Regulated flow, *Stream modification, *Regulated rivers, *History, *Rivers, *United Kingdom, Spatial distribution, Reservoirs, Dams, Interbasin transfers, Reforestation, Drainage effects, Water pollution effects, Water quality, Channeling.

Principal regulated rivers in the United Kingdom are identified and their physical and ecological characteristics are summarized. Virtually all major rivers are shown to be regulated directly or indirectly by mainstream impoundments, interbasin transfers, pumped storage reservoirs, or groundwater abstractions. Flow records for 60% of all gauging stations are significantly affected by flow manipulations. Three phases in the development of river regulation are identified: (1) the development of direct supply and compensation reservoirs from 1840, (2) the development of large dams and large-scale interbasin water transfers from 1890, and (3) the modern era of multipurpose river regulation that began in 1965. Any assessment of the environmental effects of river regulation must consider the spatial variation of natural river systems throughout the U.K, climatic changes, and the cumulative effect of river regulation and other impacts over an historic timescale. Today, the rivers of the U.K. are shown to have an underlying character that reflects the marked climate, geologic, and topographic differences between the upland north and west, and the lowland south and east (differences in part that relate to their different histories during the Pleistocene). However, many rivers show the effects of human impacts that began about 5000 years ago. Most rivers have experienced changes since about 1930 consequent upon afforestation, land drainage, and channelization. These, together with short-term climatic changes, make defining ecological impacts of river regulation problematic. Pollution has had the most dramatic effects. Nevertheless, it is suggested that the new concepts of environmentally sound river regulation could lead to the restoration, and even enhancement, of rivers in the United Kingdom. (Author's Abstract)
W89-00948

RIVER REGULATION IN THE UNITED KINGDOM: AN HISTORICAL PERSPECTIVE,
Institute of Terrestrial Ecology, Huntingdon (England). Monks Wood Experimental Station.
J. Sheail.
Regulated Rivers Research and Management RRRMEP, Vol. 2, No. 3, p 221-232, July-August 1988. 3 fig, 32 ref.

Descriptors: *Stream modification, *Regulated rivers, *Rivers, *United Kingdom, *History, *Dams, *Legislation, Water resources development, Drainage, Public policy.

The beginnings of direct river modification in the U.K. are traced back to the 1st century A.D. when works were undertaken for land drainage and transportation. After the Roman period, river works were widespread with there being more than 5000 water-mills by 1086 but these were small scale until the 17th century. Impressive drainage schemes were supplemented from the end of the 18th century by the construction of numerous small dams to supply water and provide compensation water. Severe pollution during the mid-19th century led eventually to an organized system of river management. By 1900, the era of large dam buildings and large (> 1000 km) inter-basin transfers had begun. The regulation of rivers in the U.K. has been subjected to much public scrutiny and debate, more so than the development of any other resource. However, the problems being encountered in river management today are shown to be embedded in the history of water resource development. (Author's abstract)
W89-00949

RIVER REGULATION: A REGIONAL PERSPECTIVE - NORTHUMBRIAN WATER AUTHORITY,
Northumbrian Water Authority, Gosforth (England).
P. Johnson.
Regulated Rivers Research and Management RRRMEP, Vol. 2, No. 3, p 233-255, July-August 1988. 9 fig, 37 ref.

Descriptors: *Regulated rivers, *Water management, *River regulations, *United Kingdom, *River Tyne, *River Tees, *Water quality, Hydropower, Legal aspects, Riparian rights, Regional developement, Northumbrian Water Authority, River.

The concept and operation of river regulation with reference to the Northumbrian Water Authority region in the U.K. is reviewed. The role of regulating the Rivers Tyne and Tees is considered within a regional perspective. Regulation began on the River Tees in 1965 and the regulation potential of the region was completed with the Kielder Scheme on the River Tyne in 1981. During the year, regulation in Teesdale is largely determined by abstraction demands. Hydropower releases from Kielder have an important effect on the River Tyne. The control patterns and priorities are discussed in general and specifically with regard to statutory and other requirements. These include: minimum maintained flows, drought orders, riparian and amenity interests, water quality, and ecology. Flexibility and cooperation are key concepts, the management of water quality remains arguably the major problem. (Author's abstract)
W89-00950

REGULATION OF THE RIVER DEE,
Welsh Water Authority, Powys.
A. Lambert.
Regulated Rivers Research and Management RRRMEP, Vol. 2, No. 3, p 293-308, July-August 1988. 6 fig, 4 tab, 11 ref, append.

Descriptors: *Regulated rivers, *River regulations, *Whales, *Operating policies, *River Dee, *Environmental effects, Benefits, Reservoir operation, Political aspects, Regional planning, Drought.

The interdisciplinary approach statutorily adopted for the management of the intensively regulated River Dee in the United Kingdom is discussed. The role of the Dee Consultative Committee is discussed and the procedures and methods for river regulation are described. Particular problems arise during severe droughts and a Conservation Rule Curve, using the aggregated storage of the two main reservoirs, has been devised to act as the trigger for optional initiation of water conservation measures. The social and environmental benefits of the integrated management scheme are demonstrated. Areas of conflict have been, and must continue to be, resolved by consultation, cooperation, and compromise. (Author's abstract)
W89-00953

REGULATING THE RIVER SEVERN,
Severn-Trent Water Authority, Birmingham (England).
J. R. Douglas.
Regulated Rivers Research and Management RRRMEP, Vol. 2, No. 3, p 309-321, July-August 1988. 2 fig, 1 tab, 10 ref.

Descriptors: *Regulated rivers, *Regulated flow, *Reservoirs, *Reservoir operation, *River flow, *Wales, Bristol Channel, United Kingdom, Severn River, Catchment areas, Water resources development, Drought, Model studies.

The geography of the River Severn's catchment area, from its source in central Wales to the Bristol Channel where it flows into the sea, is described. The historical development of the Severn as a water resource, culminating in the construction of Llyn Clywedog and more recently the Shropshire Groundwater Scheme to augment low river flows and support greatly increased abstractions is considered. Plans for even more substantial development of the resource system appropriate to the rapid demand growth of the 1960s and early 1970s are discussed. Practical experience in regulating flows in the river gained during the drought of 1976 is used to explain recent developments in the practice and monitoring of river regulation. (Author's abstract)
W89-00954

REGULATION OF THE RIVER THAMES: A CASE STUDY ON THE TEDDINGTON FLOW PROPOSAL,
Thames Water Authority, Reading (England).
J. R. Sexton.
Regulated Rivers Research and Management RRRMEP, Vol. 2, No. 3, p 323-333, July-August 1988. 2 fig, 2 tab, 5 ref.

Descriptors: *Regulated rivers, *Regulated flow, Rivers, *Thames River, *Teddington Flow Proposal, *Operating policies, *Environmental effects, England, Competing use, Economic aspects, Drought, water quality.

The inception, development and assessment of the Teddington Flow Proposal for the River Thames is discussed. The proposal modifies existing flow regulation policy to provide an additional 170 Ml/d for supply. After extensive studies concerning water quality, water levels, and the potential effects on ecology, navigation, recreation and amenity, no significant detrimental effects have been identified. The overall effect of the Teddington Flow Proposal would be beneficial. The river environment would be improved in major drought years, when the most serious effects on the river would otherwise occur. This more than offsets a small detioration in certain factors in some non-drought years. The biggest benefit will be to the five million people living, and the even greater number working, in London who have less frequent and less severe restrictions on their water supply with virtually no consequential increase in their water charges. (Author's abstract)
W89-00955

RIVER REGULATION BY SEASONAL GROUNDWATER ABSTRACTION: THE CASE OF THE RIVER ITCHEN,
Southern Water Authority, Otterbourne (England). Hampshire Div.
For primary bibliographic entry see Field 4B.
W89-00956

Field 4—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4A—Control Of Water On The Surface

HYDROLOGICAL CHANGES AND THE RIVER REGULATION IN THE UK,
University Coll. of Wales, Aberystwyth. Dept. of Geography.
G. Higgs, and G. Petts.
Regulated Rivers Research and Management RRRMEP, Vol. 2, No. 3, p 349-368, July-August 1988. 11 fig, 2 tab, 40 ref.

Descriptors: *Regulated rivers, *Reservoir effects, *Regulated flow, *Rivers, *Flow regimes, *Floods, *Severn River, Flood frequency, Hydrology, Interbasin transfer, Water supply, Wastewater disposal, Climate.

Research on hydrological changes due to river regulation in the U.K. is reviewed and a case study of the River Severn is presented to evaluate the influence of Clywedog Reservoir on flood magnitude and frequency. Consequent upon dam construction, average median flows have been reduced by about 50%; mean annual floods have been reduced by about 30%; and low flows have been maintained at about 22% higher than the natural Q sub 95 discharge. However, marked differences exist between rivers. The direct effect of reservoir compensation flows and indirect effect of interbasin transfers for supply have significantly increased minimum flows in most rivers, although this involves the discharge of treated effluents. In contrast, the effects of impoundments on flood magnitude and frequency is less clear and on the River Severn, at least, changes in flood hydrology during the past two decades are shown to be more related to climate change than to river regulation. (Author's abstract)
W89-00957

CHANNEL CHANGE AND SEDIMENT TRANSPORT IN REGULATED U.K. RIVERS,
Freshwater Biological Association, Ambleside (England).
For primary bibliographic entry see Field 2J.
W89-00958

IMPACT OF RIVER REGULATIONS ON INVERTEBRATE COMMUNITIES IN THE U.K.,
Nature Conservancy Council, Peterborough (England).
P. J. Boon.
Regulated Rivers Research and Management RRRMEP, Vol. 2, No. 3, p 389-409, July-August 1988. 3 fig, 4 tab, 105 ref.

Descriptors: *Dam effects, *England, *Wales, *Regulated rivers, *Invertebrates, *Reservoirs, *Interbasin transfers, *Benthos, *Flow augmentation, *Life cycles, Flow augmentation, Life cycles.

A literature review of the impact of river regulation on invertebrates in the U.K. was performed. Four conclusions were drawn: (1) the majority of studies on invertebrates describe the effects of impoundments, (2) most of the work on rivers downstream from impoundments has centered on four areas of the U.K. - Teesdale, Northumberland, North Wales, and mid-Wales, (3) studies are extremely variable in terms of duration and sampling frequency, and (4) most work on the effects of regulation on invertebrates has involved comparisons between regulated rivers and nearby similar, but unregulated, stretches. During dam construction, invertebrate diversity and abundance decreases. Longer term alterations in community structure reflect changes in flow, substrate, temperature and water quality. In particular, adverse effects on invertebrates have been attributed to a reduction in substrate heterogeneity together with an accumulation of sediment. Responses to impoundment within taxonomic groups are highly variable. Little is known about the effects of inter-river transfers on invertebrates, but it has been suggested that changes in flow velocity, water chemistry, suspended solids and temperature together with translocation of organisms are all likely to be important. The limited information available for groundwater schemes indicates that they are not detrimental to invertebrates. Their impact, however, is dependent upon factors such as the extent and timing of flow augmentation. It is suggested that there is scope for positive management of invertebrate communities through river regulation, although present attitudes and practices do not encourage this. Many gaps in our knowledge still remain and these are discussed in relation to future research needs. (Miller-PTT)
W89-00959

FISH AND FISHERIES OF REGULATED RIVERS IN THE UK,
Institute of Terrestrial Ecology, Huntingdon (England). Monks Wood Experimental Station.
For primary bibliographic entry see Field 8I.
W89-00960

RIVER REGULATION AND NATURE CONSERVATION,
Nature Conservancy Council, Peterborough (England).
J. M. Hellawell.
Regulated Rivers Research and Management RRRMEP, Vol. 2, No. 3, p 425-443, July-August 1988. 1 fig, 4 tab, 15 ref.

Descriptors: *Regulated rivers, *Regulated flow, *Environmental effects, *Conservation, Legislation, Reservoirs, Dam effects, Channel improvement, Interbasin transfer, Ecological effects.

The ecological phenomena associated with river regulation are explored with respect to their possible consequences for nature conservation. River regulation involves considerable manipulation. This extends beyond the modification of discharge regimes through the need for ancillary operations, including the construction of dams, channel modification and transfer of water between catchments. The imposition of regulation modifies the natural environment in which the original communities of organisms became established. Where the ecological requirements of these organisms are destroyed or modified beyond the limits of their adaptations or tolerances, they are unable to survive. The communities are thus changed and replaced by others, perhaps of lesser conservation value. Since the aims of nature conservation and river regulation are intrinsically incompatible, the best that can be hoped for is that regulation schemes are designed, constructed and operated as to ameliorate environmental damage. (Author's abstract)
W89-00961

ENVIRONMENTALLY SOUND RIVER ENGINEERING EXAMPLES FROM THE THAMES CATCHMENT,
Thames Water Authority, Reading (England).
J. L. Gardiner.
Regulated Rivers Research and Management RRRMEP, Vol. 2, No. 3, p 445-469, July-August 1988. 7 fig, 5 tab, 26 ref.

Descriptors: *Regulated rivers, *Thames Catchment, *Channeling, *Catchment areas, Environmental effects, Planning.

New approaches to river channel engineering work in the U.K. and the constraints to the achievement of environmentally sound schemes were examined. The approaches are being developed by an inter-disciplinary team at Thames Water. Before 1981, institutional demarcation passively encouraged the tendency toward treating symptoms of such catchment problems rather than investigating and dealing with the causes. Environmentally sound river engineering is shown not to be achieved solely by application of a range of sensitive design and construction techniques. These affect only the cross-sectional or at best local planform design and must themselves be underpinned by thorough knowledge of what constitutes the river environment and the associated geomorphological processes. Long-term environmental soundness can only come through sustaining the dynamism of the river system. Such management is shown to require a recognized structure of multidisciplinary, interorganizational teamwork, supported by appropriate legislation, institutional policy and strategy, individual awareness of the issue, and a facilitating methodology. The progress of major projects from a base level of thorough problem definition through successive levels of iterative refinement, involving interactive teamwork fully supported by appropriate use of new technology to define the best practical environmental option available. The resulting river engineering should be environmentally sound and a program of post-investment appraisal is necessary to provide feedback for the judgement to be made. (Author's abstract)
W89-00962

OUTSTANDING PROBLEMS IN RIVER REGULATION,
Severn-Trent Water Authority, Birmingham (England).
R. Wood.
Regulated Rivers Research and Management RRRMEP, Vol. 2, No. 3, p 471-477, July-August 1988. 5 ref.

Descriptors: *Regulated rivers, *United Kingdom, *River basins, *Environmental effects, *Legislation, *Water pollution control, Competing use, Water quality standard, Legal aspects.

The success of integrated river basin management in England and Wales for the past fourteen years is reviewed and forthcoming changes in legislation are critically examined. A number of problems facing the emergent National Rivers Authority are discussed. The need for co-operation rather than conflict is advocated wherever environment is to be protected and when competing pressures impact on river resources. A number of technical issues remain unresolved, such as how river water quality objectives should be established and who should set them. The need for continuing work is recognized. (Miller-PTT)
W89-00963

GRADIENT DYNAMIC PROGRAMMING FOR STOCHASTIC OPTIMAL CONTROL OF MULTIDIMENSIONAL WATER RESOURCES SYSTEMS,
Iowa State Univ., Ames. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W89-00979

EX POST ANALYSIS OF FLOOD CONTROL: BENEFIT-COST ANALYSIS AND THE VALUE OF INFORMATION,
International Food Policy Research Inst., Washington, DC.
For primary bibliographic entry see Field 6C.
W89-00983

INTENSIVE HYDRO DEVELOPMENT OF THE HONGSHUI RIVER,
Ministry of Water Resources and Electric Power, Beijing (China).
For primary bibliographic entry see Field 8C.
W89-01002

DEVELOPING RELEASE SCHEDULES FOR A GATED SPILLWAY,
Irrigation Design Organization, Roorkee (India).
For primary bibliographic entry see Field 8A.
W89-01006

STREAMFLOW REGULATION AND FISH COMMUNITY STRUCTURE,
Massachusetts Univ., Amherst. Dept. of Forestry and Wildlife Management.
M. B. Bain, J. T. Finn, and H. E. Booke.
Ecology ECOLAR, Vol. 69, No. 2, p 382-392, April 1988. 3 fig, 1 tab, 60 ref.

Descriptors: *Environmental impact, *Fish populations, *Streamflow regulation, *Regulated flow, Natural flow, Aquatic habitats, Sampling, Model studies, Substrates, Water currents, Flow rates, Flow velocity, Discharge measurement, Stream discharge, Ecosystems, Ecology, Streams.

The effect of artificial streamflow fluctuations on stream fish communities was evaluated by compar-

ing fish densities, in species and habitat groups, between two rivers differing in daily flow regime: one with natural flow, and one with highly regulated flows. A simple model was developed describing the relationship between available stream habitat and it use by 15 species or size classes of fish in the natural river. Species and size classes that used a specific set of microhabitat conditions were identified by comparing habitat characteristics for samples with and without each type of fish; for fish that used a particular type of microhabitat, species and size classes were grouped according to similarity in microhabitat use. Stream habitat samples were categorized in both the natural and regulated rivers into groups on the basis of fish habitat use criteria. Fish densities for each fish and habitat group were then individually compared between two rivers. An abundant and diverse group of small-fish species and size classes were restricted to a microhabitat that was characterized as shallow in depth, slow in current velocity, and concentrated along stream margins. Another fish group included species and size classes that used either a broad range of habitat or a microhabitat that was deep, fast, or both, and was concentrated in midstream areas. Highly variable and unpredictable flow regimes appear to be a high frequency disturbance that affects fish differently depending on the way they use stream habitat and acts to reduce community complexity. (Author's abstract)
W89-01053

4B. Groundwater Management

ESKER AQUIFERS,
Caswell, Eichler and Hill, Inc., West Topsham, VT.
B. Caswell.
Water Well Journal WWJOA9, Vol. 42, No. 7, p 36-37, July 1988. 3 fig.

Descriptors: *Esker aquifers, *Surface-groundwater relations, *Glacial aquifers, *Geohydrology, *Groundwater recharge, *Groundwater movement, Permeability coefficient, Path of pollutants, Infiltration, Hydraulic conductivity, Maine, Hydraulic coupling, Hydrology, Aquifers, Aquifer characteristics, Solute transport, Groundwater management, Sediments, Wells, Groundwater.

The characteristics of an esker aquifer in Maine are described to illustrate the properties of eskers that are important to their functioning as aquifers. The hydrogeologic aspects of eskers illustrated by this example, the most important is the long and narrow shape, which restricts the surface area available for infiltration of precipitation and thereby diminishes the volume of recharge water available to a pumping well. Most esker aquifers must induce recharge to leak from nearby surface water bodies if they are to sustain large pumping rates. The potential for hydraulic coupling between the esker gravel and a stream, pond, or lake should always be evaluated before considering an esker as a potential high-yield groundwater source. The second item of importance is the likely strong contrast in permeability between an esker and the neighboring sediments. Groundwater and any contaminants it contains may move preferentially for long distances along an esker at rates many times greater than possible in the neighboring sediments with or without the influence of a pumping well. (Alexander-PTT)
W89-00264

DEVELOPMENT AND MANAGEMENT OF GROUNDWATER RESOURCES ON DIEGO GARCIA,
Naval Facilities Engineering Command, Pearl Harbor, HI. Pacific Div.
S. W. Surface, and E. F. C. Lau.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 6, p 67-72, June 1988. 8 fig, 2 tab, 1 ref.

Descriptors: *Water supply, *Atolls, *Water treatment, *Groundwater management, *Diego Garcia, *Water resources development, Potable water, Groundwater potential, Skimming wells.

The remote atoll of Diego Garcia provides vital support to the United States missions in the Indian Ocean, the Middle East, and Africa. Population on the atoll ranges from 4,000 to 5,000 people, with average daily potable water demand approaching 800,000 gpd (3,000 ml/d). Development of a potable water supply has evolved since 1971 from temporary dug wells, to distillation, to brackish water desalination by electrodialysis, and finally to development of fresh groundwater by more than 100 low-yield, shallow, skimming wells that provide a reliable, cost effective, and operationally simple freshwater supply system. The lessons learned indicate that the development of water resources on atolls should begin with an investigation of fresh groundwater, which could be the least costly to develop and easiest to operate. The monitoring system that was developed affords a practical method to explore, understand, and manage groundwater resources on an atoll. (Author's abstract)
W89-00423

REMOTE SENSING APPLICATIONS IN WATER RESOURCE PROSPECTING AND MANAGEMENT,
International Bank for Reconstruction and Development, Washington, DC. Water and Telecommunications Div.
For primary bibliographic entry see Field 7B.
W89-00459

HISTORICAL USE OF GROUND WATER IN TERRELL, TEXAS,
IT Corp., Terrell, TX.
B. Kent.
Southwest and Texas Water Works Journal, Vol. 70, No. 3, p 7-9, June 1988.

Descriptors: *Groundwater mining, *History, *Water use, *Terrell, Texas, Water supply, Wells, Water resources development, Aquifers.

In the late 1890's Terrell was one of fewer than 40 towns in Texas that had developed a public water supply system from groundwater. The Texas and Pacific Railroad was completed from Dallas to Longview in 1873. The water supplies along this route were not always of good quality or dependability. Two aquifer systems were available for use by Terrell residents and industries. The first zone was generally less than 20 feet deep, and wells in this zone supplied the majority of the residents. Most houses had their own hand-dug wells completed in this shallow zone. The second aquifer (Nacatoch Sand) was found in Terrell at depths of 50 to 100 feet and was generally about 20 feet thick. Wells that produced 30 to 50 gallons per minute could be made in this zone. The abundance of good quality water made Terrell a major trade center. The original Terrell Public Water Works was built by the city in 1884 and was leased to Terrell Ice, Light and Power. However, by 1895 the city had regained control of the supply. As Terrell grew in the early 1900's, the water supply for the municipality became inadequate. The 50- to 100- foot wells were unable to supply the demand for modern living. Because of the inability to find deeper, larger volume potable supplies, Terrell turned to surface water in 1922 and the old Terrell City Lake was constructed east of town. With the conversion to surface water, the city water wells were abandoned. In the drought of the 1950's, the city lake began to dry up. Several of the old wells were drilled in Terrell and at the State Hospital grounds. Good quality groundwater still exists under and near Terrell today. However, because of the availability of surface water at reasonable cost, it is unlikely that many people will exploit this resource unless population growth and drought conditions combine to create the demand for additional resources. (Lantz-PTT)
W89-00461

GROUNDWATER RIGHTS: DEFINITION AND TRANSFER,
Clark Univ., Worcester, MA. Graduate School of Geography.
For primary bibliographic entry see Field 6E.
W89-00838

RIVER REGULATION BY SEASONAL GROUNDWATER ABSTRACTION: THE CASE OF THE RIVER ITCHEN,
Southern Water Authority, Otterbourne (England). Hampshire Div.
D. M. Giles, V. A. Lowings, and P. Midgley.
Regulated Rivers Research and Management RRRMEP, Vol. 2, No. 3, p 335-347, July-August 1988. 6 fig, 9 ref.

Descriptors: *Regulated flow, *Conjunctive use, *England, *Regulated rivers, *Groundwater management, *Itchen River, *Model studies, Mathematical models, Seasonal variation, Water supply development.

The development of groundwater to regulate the flows of the River Itchen in Southern England are described. The permeable chalk geology of the river catchment makes the use of groundwater storage more cost effective than conventional surface reservoirs. The principles of groundwater regulation and the construction and testing of the first two schemes are described. Flow extension and mathematical modeling have been used to assess yields and assist with operational decisions. It is concluded that groundwater regulation is a viable alternative to reservoirs in permeable catchments and further schemes are planned. (Author's abstract)
W89-00956

MANAGEMENT OF A TRIBUTARY AQUIFER,
New Mexico Univ., Albuquerque. Dept. of Economics.
H. S. Burness, and W. E. Martin.
Water Resources Research VRERAO, Vol. 24, No. 8, p 1339-1344, August 1988. 5 ref, append.

Descriptors: *Water rights, *Groundwater management, *Model studies, *Economic aspects, *Surface-groundwater relations, *Aquifer management, Aquifer systems, Groundwater hydrology, Hydrologic models, Tributaries, Groundwater movement, Groundwater.

Much work has been done concerning the integration of hydrologic and economic considerations for a nontributary aquifer, but to date there has been a paucity of economic analyses concerning tributary aquifers. In this paper an analytical economic model is developed that focuses primarily on the hydrologic link between surface water and groundwater as it relates to efficient plans for water pumping from a tributary aquifer. The allocative efficiency of competitive markets for such water is then examined. When maximum water demand is less than or equal to pumping surface flows, the optimal solution generally requires that pumping be equal to maximum demand in every time period. At the steady state, instantaneous river effects are equal to pumping net river flows are positive, and a positive stock of water remains in the aquifer. This corresponds to the usual hydrologic equilibria imposed on engineering models of tributary aquifers. If entitlements to water are clearly defined, then competitive markets will ensure an optimal allocation of water. However, with many small water users it is possible, and perhaps even likely, that river effects may be difficult to identify. As a consequence there may be a role for a central authority to oversee the utilization of water and, in particular, adopt a policy in this regard to ensure that river effects are not ignored. (Friedmann-PTT)
W89-00978

IN-SITU METHOD FOR MONITORING LAYERED HYDRAULIC IMPEDANCE DEVELOPMENT DURING ARTIFICIAL RECHARGE WITH TURBID WATER,
North Dakota State Water Commission, Bismarck.
For primary bibliographic entry see Field 2F.
W89-01205

NEW DIRECTIONS IN NEBRASKA WATER POLICY,
Nebraska Univ.-Lincoln. Dept. of Agricultural Economics.

For primary bibliographic entry see Field 6E.
W89-01266

RECURRING STATE JUDICIAL TASK OF CHOOSING RULES FOR GROUNDWATER LAW: HOW OCCULT STILL,
Ohio State Univ., Columbus. Coll. of Law.
For primary bibliographic entry see Field 6E.
W89-01268

4C. Effects On Water Of Man's Non-Water Activities

TROPICAL WETLANDS AS A CARBON SOURCE,
North Carolina Univ. at Wilmington. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2H.
W89-00118

INHABITANTS' LIFE IN THE LOWLAND OF THE KISO, NAGARA AND IBI RIVERS, (IN JAPANESE),
Tokai Univ., Hiratsuka (Japan).
For primary bibliographic entry see Field 4A.
W89-00205

URBAN RUNOFF SIMULATION MODEL,
Texas A and M Univ., College Station. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W89-00301

REDUCTION OF A DOLLY VARDEN POPULATION AND MACROBENTHOS AFTER REMOVAL OF LOGGING DEBRIS,
Alaska Dept. of Fish and Game, Juneau.
S. T. Elliott.
Transactions of the American Fisheries Society TAFSAI, Vol. 115, No. 3, p 392-400, May 1986. 3 fig, 4 tab, 33 ref.

Descriptors: *Ecological effects, *Dolly Varden, *Logging, *Debris, *Fish, Population dynamics, Biomass, Macroinvertebrates, Benthic environment.

Logging debris resident for five or more years in small streams of southeastern Alaska is frequently removed to improve salmonid habitat. This practice was evaluated for its effects on juvenile anadromous Dolly Varden Salvelinus malma and macrobenthos populations in a small spring-fed stream during 1973-1981. Debris, consisting of limbs, needles, and fragmented logs, was removed by hand from the entire stream in July 1976. The surface area, number, and size of pools was reduced thereafter, and the water velocity increased. Macrobenthos density and invertebrate drift decreased 60-90% immediately after debris removal but returned to pretreatment levels in 1977. The Dolly Varden population decreased from 900 to < 100 fish by 1978 and then fluctuated sharply between late 1978 and 1981. After 1978, Dolly Varden averaged 27 mm less in length and their biomass decreased from 12.5 to 3.9 g/sq m. Decrease in fish standing crop occurred in two stages: (1) an initial loss of larger fish due to reduced habitat; (2) loss of smaller individuals during November freshets thereafter. This study indicates that removal of old logging debris does not improve habitat and can result in smaller rearing populations. Old debris should not be removed unless a block to migrating adult spawners or impairment of water quality can be demonstrated. (Author's abstract)
W89-00322

RUNOFF GENERATION IN A PLOUGH-DRAINED PEAT BOG IN SOUTHERN SCOTLAND,
Centro de Estudos de Pedologia, Lisbon (Portugal).
J. S. David, and D. C. Ledger.
Journal of Hydrology JHYDA7, Vol. 99, No. 3/4, p 187-199, May 30, 1988. 7 fig, 1 tab, 22 ref.

Descriptors: *Drainage ditches, *Rainfall-runoff relationships, *Drainage effects, *Surface-groundwater relations, *Agricultural runoff, *Peat soils, *Runoff plots, Runoff rates, Scotland, Reforestation, Forestry.

Runoff plots and other equipment were used to study runoff generation in a peat bog in Scotland four years after it had been plough-drained for afforestation. In generally dry periods runoff responses were dominated by flow generated by rain falling directly onto the ditches. Only during very wet periods was the source of runoff less important than water draining into the ditches from the strips on either side. Flow from the strips to the ditches consisted entirely of groundwater. This occurred at a very low rate unless the water table was within 6-7 cm of the surface; then it could become as rapid as the rate at which rain landed on the area. The results emphasize the need to consider the ditches and the strips between them separately when seeking an understanding of runoff generations in densely plough-drained peatland. (Author's abstract)
W89-00345

EFFECT OF LOGGING AND REGENERATION ON GROUNDWATER, STREAMFLOW AND STREAM SALINITY IN THE SOUTHERN FOREST OF WESTERN AUSTRALIA,
Water Authority of Western Australia, Perth.
H. Borg, G. L. Stoneman, and C. G. Ward.
Journal of Hydrology JHYDA7, Vol. 99, No. 3/4, p 253-270, May 30, 1988. 6 fig, 3 tab, 27 ref.

Descriptors: *Logging, *Clear-cutting, *Reforestation, *Groundwater level, *Stream discharge, *Salinity, Water table fluctuations, Catchment areas, Surface-groundwater relations, Australia.

In the late 1960s the Forests Department of Western Australia decided to change its logging strategy in the southern forest from light selection cutting to heavy selection cutting and clear-felling. Four small catchments (Crowea, Poole, Iffley and Mooralup) were selected in 1975 to study the effect of heavy selection cutting and clear-felling followed by regeneration on streamflow, stream salinity and groundwater levels. The catchments were logged between November 1976 and March 1978. Regeneration began within eighteen months after the completion of logging. During the study (1976-1985) the annual rainfall in the region was generally below the long-term mean. This probably influenced the magnitude and duration of the hydrologic response to logging and regeneration, but not the general trends. Groundwater levels rose for 2-4 yr after logging and then started to fall again. They can be expected to reach the values they would have been at without logging within 15 yr after the beginning of regeneration. In the relatively dry Mooralup catchment, logging had little effect on the groundwater level. As a result of logging, streamflow increased for two years (1977 and 1978) and then gradually declined again as the vegetation regenerated. Streamflow is also likely to be back to pre-logging values within 15 yr after the beginning of regeneration. In the Mooralup catchment, where streamflow volumes are naturally small, this may have happened after 6 yr of regeneration. Flow-weighted mean annual stream salinities rose for one-three years after logging but have declined since. Even at their highest level they remained below the upper limit for high-quality drinking water. Stream salinities are likely to return to the level they would be at without logging at the same time as streamflow and groundwater levels. (Author's abstract)
W89-00350

REPERCUSSIONS OF A CO2 DOUBLING ON THE WATER CYCLE AND ON THE WATER BALANCE - A CASE STUDY FOR BELGIUM,
Institut Royal Meteorologique de Belgique, Brussels. Hydrology Section.
For primary bibliographic entry see Field 2A.
W89-00355

EFFECTS OF STREAM CLEANING ON JUVENILE COHO SALMON AND DOLLY VARDEN IN SOUTHEAST ALASKA,
Pacific Northwest Forest and Range Experiment Station, College, AK. Inst. of Northern Forestry.
For primary bibliographic entry see Field 2H.
W89-00374

EFFECTS OF SEASON AND SUBSTRATE ON AVAILABILITY OF DRIFT FOR FISH IN A SMALL WARMWATER STREAM,
Illinois Univ. at Urbana-Champaign. Dept. of Ecology, Ethology and Evolution.
For primary bibliographic entry see Field 2H.
W89-00400

EFFECTS OF DISTURBANCES ALONG HYDROELECTRICAL TRANSMISSION CORRIDORS THROUGH PEATLANDS IN NORTHERN MANITOBA, CANADA.
Rannsoknastofnun Landbunadarins, Reykjavik (Iceland).
B. Magnusson, and J. M. Stewart.
Arctic and Alpine Research ATLPAV, Vol. 19, No. 4, p 470-478, November 1987. 5 fig, 2 tab, 43 ref.

Descriptors: *Ecology, *Forests, *Peatlands, *Vegetation regrowth, *Electric power lines, *Water pollution effects, *Arctic zone, *Environmental effects, Species diversity, Plant growth, Soil water, Permafrost, Erosion, Chemical properties, Electric power industry, Ecological effects, Herbicides, Vegetation.

Understory vegetation and soil factors were studied in forested peatlands along two power lines extending between 50 and 56 degrees N in Manitoba, Canada. At 16 sites, comparisons were made between the cleared right-of-ways and adjacent undisturbed forest communities. The primary sources of disturbances in the right-of-ways were (1) initial clearance and line construction, (2) traffic, and (3) vegetation management with herbicides. Vegetation in the right-of-way is distinguished by altered species abundances rather than changes in floristic composition. The right-of-way community had generally lower abundances of Sphagnum fuscum and ericoid shrubs and a significantly greater extent of exposed peat. Polytrichum strictum was the only species with a higher abundance in the right-of-way. Water chemistry indicated a slight enrichment of the right-of-way environment. The thawing of permafrost in the northern right-of-way sites and subsequent erosion occurred only in areas of heavy traffic. Use of the tree/shrub herbicide picloram in the right-of-way has led to the additional and ecologically undesirable disappearance of such nontargeted species as Sphagnum fuscum. (Author's abstract)
W89-00436

STREAM CHEMISTRY IN THE NEW JERSEY PINELANDS: THE INFLUENCE OF PRECIPITATION AND WATERSHED DISTURBANCE,
Rutgers - The State Univ., Camden, NJ. Dept. of Biology.
For primary bibliographic entry see Field 5B.
W89-00716

EVALUATING PEAT-MINING HYDROLOGY USING DRAINMOD,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Engineering.
K. D. Konyha, K. D. Robbins, and R. W. Skaggs.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 114, No. 3, p 490-504, August 1988. 7 fig, 2 tab, 6 ref.

Descriptors: *Peat bogs, *Catchment areas, *Geohydrology, *Wetlands, *Rainfall-runoff relationships, *Mine drainage, *Simulation, *Models studies, *Land use, *Hydrologic models, *Land reclamation, Agricultural hydrology, Detention reservoirs, Computer programs, Peat, Watersheds, Runoff, Flood peak, Environmental effects.

A process that used the field-scale model DRAINMOD to simulate the hydrologic response of a watershed to peat mining is presented. An eastern North Carolina watershed has been proposed as

the site of a peat mining project. Within the watershed are several distinct soils, land uses, and drainage characteristics. Land use, drainage, and even soil characteristics change as peat soil is mined and reclaimed. The hydrologic response of this watershed is determined for each year of the proposed mining project by combining the field hydrology model with a simple reservoir model, a spreadsheet program, and a statistical program. Results show that peat mining alone increases the annual runoff volume and peak outflow rates. However, by mining land in small sections, by reclaiming the land for agricultural and forest uses, and by installing water retention reservoirs, the annual runoff and peak daily flows from the watershed can be reduced to the magnitude of those presently occurring on the unmined site. (Author's abstract)
W89-00755

NATURE CONSERVATION IN THE MORAY FIRTH,
Nature Conservancy Council, Edinburgh (Scotland).
For primary bibliographic entry see Field 2L.
W89-00776

OIL POLLUTION IN THE CROMARTY FIRTH AND INSHORE MORAY FIRTH,
Nature Conservancy Council, Edinburgh (Scotland).
For primary bibliographic entry see Field 5B.
W89-00785

ECOLOGY OF MACROALGAE IN THE FIRTH OF CLYDE,
Liverpool Univ., Port Erin (England). Dept. of Marine Biology.
For primary bibliographic entry see Field 2L.
W89-00815

QUANTITY OF STORMWATER RUNOFF FROM TEN STRETCHES OF ROAD, A CAR PARK AND EIGHT ROOFS IN HERTFORDSHIRE, ENGLAND DURING 1983,
University Coll., London (England). Dept. of Geography.
G. E. Hollis, and J. C. Ovenden.
Hydrological Processes HYPRE3, Vol. 2, No. 3, p 227-243, July-September 1988. 1 fig, 15 tab, 3 ref. Natural Environment Research Council Grant GR3/4442.

Descriptors: *Rainfall-runoff relationships, *Runoff volume, *Storm runoff, *Urban runoff, *Runoff coefficient, *Urban hydrology, Surface runoff, Roads, Depression storage, Rainstorms, Buildings, Paving.

Rainfall and runoff were monitored simultaneously for one year from a residential road, a car park, nine sections of road draining to individual gullies, two house roofs, two garage roofs, and three types of factory roof. The sites, which included an automatic weather station, were in Redbourn, Hertfordshire on Flood Studies Report Soil Type a. The 2906 quality controlled 'station-storms' represented 193 rain storms and involved 57.2% of the annual rainfall. 1732 storms were of $<$ 1.4 mm of rain, while 77 had $>$ 10 mm. The runoff averaged 11.4% for roads and 56.9% for roofs. Percentage runoff from the roads was cyclic with a peak during the summer months but there was a marked variation in monthly percentage runoff within and between sites. Regression analysis to explain percentage runoff was undertaken with various subsets of data for each site, roads, and roofs. The variable values in percentage runoff could not be explained satisfactorily with statistical methods. Only eight of the 72 equations explained more than 57% of the variance. The most explanatory variables for roads were short term rainfall intensity and rainfall amount; intensity was the most important for roofs. Depression storage, assessed by examining rainfalls that did and did not produce runoff, showed a diversity of monthly values. There were no relationships between depression storage and catchment or roof slope. Peak runoff from the roads showed an attenuation of 12.8% for 1 minute rainfall intensities and 24.2% for 5 minute intensities. For roofs, the attenuation averaged 36.8% for 1 minute and 92.6% for 5 minute intensities. Total rainfall was an important explanatory variable as was the slope of the road. There was evidence that peak coefficients for roads are greater during the summer. (Author's abstract)
W89-00912

ASSESSING THE INFLUENCE OF ENVIRONMENTAL PARAMETERS ON THE HYDROLOGICAL CYCLE,
General Hydrological Station of Anhui Province (China).
For primary bibliographic entry see Field 2A.
W89-00916

REGULATED RIVERS IN THE UNITED KINGDOM,
Loughborough Univ. of Technology (England). Dept. of Geography.
For primary bibliographic entry see Field 4A.
W89-00948

CALIFORNIA TAHOE CONSERVANCY: APPLYING THE PRINCIPLES,
California Tahoe Conservancy, Lake Tahoe.
For primary bibliographic entry see Field 6E.
W89-01068

EFFECTS OF LEACHING AND WHOLE-TREE HARVESTING ON CATION BUDGETS OF SEVERAL FORESTS,
Oak Ridge National Lab., TN. Environmental Sciences Div.
D. W. Johnson, J. M. Kelly, W. T. Swank, D. W. Cole, and H. Van Miegroet.
Journal of Environmental Quality JEVQAA, Vol. 17, No. 3, p 418-424, July-September 1988. 4 fig, 2 tab, 26 ref. EPA Interagency Agreement 79DX0533, Electric Power Research Institute RP 1813-1, and DOE Contract DE-AC05-84OR21400.

Descriptors: *Forest hydrology, *Soil water, *Soil chemistry, *Forest soils, *Leaching, *Acid rain, Whole-tree harvesting, Cations, Calcium, Bicarbonates, Anions, Sulfates, Soil types.

The effects of acid deposition, natural leaching, and harvesting on base-cation export from forests in Maine, Tennessee, South Carolina, North Carolina, and Washington were compared. Based on previous literature, it was hypothesized that base-cation export via whole-tree harvesting (WTH) would be nearly independent of soil exchangeable base-cation supplies and that base-cation export via leaching would be strongly dependent on the exchangeable cation supplies as well as the input, production, and mobility of anions. This hypothesis was supported by the data: mixed deciduous sites in Tennessee had among the highest base-cation (principally calcium) exports via WTH, yet the lowest soil exchangeable supplies, whereas the Washington sites had by far the highest base cation leaching (due to very high levels of naturally-produced bicarbonate) and soil exchangeable supplies, yet only relatively moderate base-cation exports via WTH. Sulfate was either the dominant or a major anion in soil solutions from the eastern sites, suggesting that atmospheric deposition was a major factor in soil leaching from these sites, but total leaching rates from these sites were much lower than at the Washington sites. Indeed, some of the eastern sites showed a net annual accumulation of one or more base cations from atmospheric deposition. Some of the southeastern sites with Ultisols showed the expected net retention of sulfate, but the sites in the Tennessee Valley near Oak Ridge showed surprisingly little ecosystem sulfate retention, perhaps due to lower soil sulfate adsorption in these soils than in other Ultisols. (Author's abstract)
W89-01166

4D. Watershed Protection

GREAT LAKES SHORE EROSION,
Citadel, Charleston, SC.
M. H. Wysockey.
Journal of Environmental Sciences JEVSAG, Vol. 31, No. 3, p 19-25, May/June 1988. 7 fig, 1 tab, 56 ref.

Descriptors: *Shore protection, *Erosion, *Lakes, *Great Lakes, *Lake shores, *Beach erosion, *Water level fluctuations, Water level, Hydrologic budget, Lake basins, Storm surges, Wave action, Accelerated erosion, Coastal zone management, Diversion, Diversion losses, Sea walls, Bulkheads, Breakwaters, Groins, Replenishment, Building codes, Sea level.

Because the Great Lakes have a large surface area, lake levels rise and fall slowly. There are three basic types of fluctuation: annual, seasonal, and daily. Annual and seasonal changes result from imbalances between inflow and outflow of Great Lakes basin water. Significant daily changes result from a combination of storm winds and atmospheric pressure. Wave action and currents are the primary shapers of coastal landforms. Over the last few years, water levels in the Great Lakes have been at or above historic record levels; the high water has accelerated natural erosion processes to alarming rates. Three fundamental solution strategies are being pursued--lake level reductions by diversion of water out of the system, shore stabilization measures, and legal building restrictions. The effectiveness of diversion changes in lowering lake levels is questionable. Estimates vary, but almost all amount to under 1 in./yr (2.54 cm/yr); next to natural fluctuations of up to 8 ft (2.4 m) these changes appear relatively insignificant. The four most prevalent shoreline protection measures are: shore armoring, breakwaters, groins, and beach nourishment. The least desirable shoreline protective device is the traditional shore armor--revetments, seawalls, and bulkheads. Poorly-designed armor structures, especially seawalls, are extremely destructive and, unfortunately, not uncommon. A breakwater is similar to a seawall yet located some distance offshore; they are difficult to design due to ever-changing coastal processes. Groins are a complex protection approach because of two troublesome side effects--they pull sand out of the littoral system and can create a scouring effect on their downdrift sides. Sand replenishment is a preferred approach because it provides a favorite defense mechanism, a beach. At present, the most popular idea is that erosion is a natural, unavoidable phenomenon, and that we would be better off getting out of its way. The strategy has two basic forms: keeping construction away with 'set-back requirements' and moving existing structures back from the shore. The handling of today's problems with high lake levels may have an impact on how we will handle the problem of rising sea levels; although lake levels change slowly, they move faster than sea levels thereby expediting research. (Shidler-PTT)
W89-00133

MARSH MANAGEMENT PLANS IN PRACTICE: DO THEY WORK IN COASTAL LOUISIANA, USA,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 2L.
W89-01060

COASTAL MANAGEMENT ISSUES FOR THE MOUTH OF THE RIVER MURRAY, SOUTH AUSTRALIA,
South Australia Dept. of Environment and Planning, Adelaide.
For primary bibliographic entry see Field 6E.
W89-01072

NEW DIRECTIONS IN NEBRASKA WATER POLICY,
Nebraska Univ.-Lincoln. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6E.
W89-01266

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

FRESHWATER MOLLUSKS AS INDICATORS OF TROPHIC CONDITIONS IN COASTAL LAKES OF SOUTHERN BRAZIL (MOLUSCOS DULCEAQUICOLAS COMO INDICADORES DE CONDICOES TROFICAS EM LAGOAS COSTEIRAS DO SUL DO BRASIL),
Universitaet des Saarlandes, Saarbruecken (Germany, F.R.). Inst. fuer Biogeographie.
R. M. Lanzer, and A. E. Schafer.
Revista Brasileira de Biologia RBBIAL, Vol. 47, No. 1/2, p 47-56, February/May 1987. 5 fig, 2 tab, 40 ref. English summary.

Descriptors: *Lakes, *Mollusks, *Trophic level, *Eutrophication, *Eutrophic lakes, *Bioindicators, Aquatic habitats, Lake classification, Water depth, Transparency, Phosphorus, Chemical oxygen demand, Tropical regions, Brazil, Limnology.

The lakes located in the southern coastal lowlands of Brazil are classified into 6 types under the following parameters: maximal depth, transparency, total phosphorus and chemical oxygen demand. The analysis of the distribution of 6 mollusk species, and their preferences in relation to chemical, physical, and spatial conditions of their habitat, indicates that, on the basis of the material available, Gundlachia sp., Gundlachia concentrica and Eupera klappenbachi can be considered as indicators of eutrophic conditions in the nearshore areas. E. klappenbachi seems to be the best indicator. (Author's abstract)
W89-00008

TRACE ELEMENT CONTENT IN DRINKING WATER OF NASOPHARYNGEAL CARCINOMA PATIENTS,
Hunan Medical Coll., Changsha (China). Dept. of Environmental Medicine.
For primary bibliographic entry see Field 5C.
W89-00048

CONTINUOUS-FLOW SYSTEM FOR THE DETERMINATION OF COBALT IN SEA AND RIVER WATER: IN-LINE PRECONCENTRATION/SEPARATION COUPLED WITH CATALYTIC DETERMINATION,
Yamanashi Univ., Kofu (Japan). Dept. of Chemistry.
T. Yamane, and K. Watanabe.
Analytica Chimica Acta, Vol. 207, No. 1/2, p 331-336, April 15, 1988. 1 fig, 1 tab, 18 ref.

Descriptors: *Cobalt, *Trace metals, *Separation techniques, *Chemical analysis, Resins, Detection limits, Continuous flow, Water analysis, Seawater, Riparian waters.

Cobalt is preconcentrated on a column packed with silica-immobilized 8-quinolinol and separated in a second column packed with a strongly acidic cation-exchange resin. The catalytic action of cobalt ions on the hydrogen peroxide oxidation of protocatechuic acid is used in the determination. The detection limit is 0.005 ng/L. The recommended procedure was applied to coastal sea water and surface river water. Results obtained are in good agreement with standards. (Author's abstract)
W89-00063

USE OF MIRES IN MONITORING THE ATMOSPHERIC DEPOSITION OF HEAVY METALS,
National Water Research Inst., Burlington (Ontario). Aquatic Ecology Div.
W. A. Glooschenko, L. Holloway, and N. Arafat.
Aquatic Botany AQBODS, Vol. 25, No. 2, p 179-190, September 1986. 7 fig, 2 tab, 31 ref.

Descriptors: *Pollutant identification, *Air pollution, *Heavy metals, *Wetlands, *Monitoring, *Fallout, Bogs, Fate of pollutants, Aquatic plants, Mosses, Peat, Cores, Canada, Chemistry of precipitation, Iron, Copper, Lead, Zinc, Water pollution sources.

Bogs are ombrotrophic mire ecosystems receiving all chemical inputs from atmospheric deposition. Thus living vegetation in bogs such as Sphagnum moss and peat derived from the vegetation can be analyzed for metals in order to monitor atmospheric deposition. This can be done relative to a point source such as a smelter or for determining regional differences. A study was made in the area of the copper smelter at Rouyn-Noranda, Quebec in terms of atmospheric deposition. The moss Sphagnum fuscum was collected from 10 bogs within a 70-km radius of the smelter. The samples were analyzed for Fe, Cu, Pb, and Zn. The concentration of elements Cu, Pb, and Zn were high near the smelter and decreased exponentially to approximately 50 km, where they reached background levels. This indicates the zone of influence of the smelter in terms of atmospheric deposition. In the second part of the study, peat cores were collected from bogs located at Barrington, Nova Scotia; Sept Iles, Quebec; Luther, Ontario; and a remote site in the James Bay lowland near Moosonee, Ontario. Metals (Fe, Cu, Pb, and Zn) were analyzed at 3-cm intervals down to a depth of 1 m. In general, surface enrichment of Fe, Cu, Pb, and Zn was noted with minimal enrichment at the James Bay site. (Author's abstract)
W89-00123

USE OF PLANT MICRO-NUTRIENT AND CHLOROPHYLL RECORDS AS INDICES OF EUTROPHICATION IN INSHORE WATERS,
University Coll. of North Wales, Menai Bridge. Marine Science Labs.
C. P. Spencer.
Netherlands Journal of Sea Research NJSRBA, Vol. 19, No. 3/4, p 269-275, December 1985. 5 fig, 2 tab, 17 ref.

Descriptors: *Chlorophyll, *Eutrophication, *Micronutrients, *Hydrographs, *Phytoplankton, Bays, Liverpool Bay, England, Advection, Bioindicators.

The records for 14 years of plant micronutrient concentrations and the quantities of chlorophyll in Liverpool Bay are reviewed. The complicated and varied hydrographical regimes which characterize the area preclude the use of micronutrients as precise indicators of the extent of enrichment of the water. However, there is evidence that the area can sometimes support standing crops of phytoplankton. Advective dispersal processes and variations in their intensity are probably particularly important in controlling the magnitude of these crops of phytoplankton. It is suggested that the adequate long term records of the frequency and duration of such blooms are likely to be a more useful indication of eutrophication of the area and of any long term trends which might occur than are the hydrochemical data. (Author's abstract)
W89-00160

DETECTION AND ENUMERATION OF ACTINOMYCETES IN THE AUSTRIAN PART OF THE DANUBE BY MEANS OF SELECTIVE MEMBRANE FILTRATION METHODS TOGETHER WITH SOME OTHER BACTERIOLOGICAL PARAMETERS (NACHWEIS UND VORKOMMEN VON ACTINOMYCETEN IN DER OSTERREICHISCHEN DONAU MITTELS SELEKTIVER MEMBRANFILTERVERFAHREN, ZUSAMMEN MIT EINIGEN ANDEREN BAKTERIOLOGISCHEN PARAMETERN),
Bundesanstalt fuer Wasserguete, Vienna (Austria).
G. D. Kasimir.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 68, No. 3/4, p 479-488, May 1987. 2 fig, 2 tab, 26 ref. English summary.

Descriptors: *Danube River, *Bacterial analysis, *Water quality, Aerobic bacteria, Actinomyces, Saprophytic bacteria, Coliforms, Streptococci, Wastewater, Population density, Water level, Water sampling, Danube River, Chitin, Floods, Austria.

A method by which substrate mycelia of actinomycetes in chitin agar are counted proved to be superior to other methods for the enumeration of actinomycetes in surface waters in which they occur in relatively small numbers. The method uses the ability of actinomycetes to grow through membrane filters. As chitin, the sole source of nitrogen and carbon in this medium, is not water soluble, other bacteria growing on the upper side of the membrane filter are not able to use it and thus are restricted in their growth. Before counting, these bacteria are removed with the filter. The examination of Danube water samples showed a marked dependence of the actinomycete population density on the water level, thus documenting their terrestrial origin. A similar behavior is shown by the aerobic spore formers which are also washin forms. In contrast to the above groups of bacteria, bacteria which are of wastewater origin (saprophytes, fecal coliforms, fecal streptococci) show a more complex dependence on the water level. High water dilutes the waste-water inflow; on the other hand, the number of these bacteria, which may have a long survival time, is increased by the disturbance of the sediment in the case of high water. The bacteriological quality of the Danube water varies considerably depending on the hydrological changes. The importance of a high sampling frequency is therefore emphasized, especially when river systems are to be examined. (Author's abstract)
W89-00174

BROMOTHYMOL-BLUE TEST: A SIMPLE ALGAL BIOASSAY AND ITS USE FOR HERBICIDE SCREENING,
Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Biotechnologie.
B. Lusse, D. Schroder, and C. J. Soeder.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 73, No. 1, p 147-152, April 1986. 2 tab, 12 ref.

Descriptors: *Bioassays, *Herbicides, *Toxicity, *Algae, Chlorella, Scenedesmus, Diquat, Paraquat, Quaternary ammonium compounds, Hydrogen ion concentration, Bromothymol-blue test.

The simple bioassay described relies on the color change of the pH-indicator, bromothymol-blue, due to photosynthetic CO_2 consumption in closed small bottles. The test requires very little labor, equipment and space. Incubation time may vary between a few hours and 24 h or more. The test was applied to estimate the tolerance thresholds of the green algae, Chlorella emersonii and Scenedesmus obliquus, for quaternary ammonium herbicides. (Author's abstract)
W89-00192

COULD BENTHIC ALGAE BE USED AS WATER QUALITY INDICATORS (KONNEN BENTHISCHE ALGEN ZUR WASSERGUTEBESTIMMUNG HERANGEZOGEN WERDEN),
Oesterreichische Akademie der Wissenschaften, Vienna. Biologische Station.
E. Kann.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 73, No. 3, p 405-423, December 1986. 59 ref. English summary.

Descriptors: *Water pollution, *Water quality, *Algae, *Bioindicators, Lakes, Rivers, Germany, Alpine regions.

After introductory general remarks on different kinds of pollution, on ecological factors, on the ecological valence of algae and the significance of their quantities, observations of the influence of different pollutants on the benthic algal flora in Alpine and Northern German lakes and rivers are described. These changes consist of quantitative changes of certain algae, especially an increase of chlorophytes. In certain cases, Sphaerotilus gave an indication of heavy pollution; in other cases (two Alpine lakes), the disappearance or marked decrease of some Cyanophytes was seen. There is no single algae species which can be used as an indicator organism for a particular kind of pollution with certainty but this does not hold true for the sewage bacterium, Sphaerotilus. (Sand-PTT)

W89-00194

CATALYTIC DETERMINATION OF COPPER IN NATURAL WATER AT MICROGRAM/L LEVEL BY FLOW INJECTION ANALYSIS, (IN CHINESE),
Yellow Sea Fisheries Research Inst., Qingdao (China).
For primary bibliographic entry see Field 7B.
W89-00201

DETERMINATION OF NAPHTHENIC ACIDS IN CALIFORNIA CRUDES AND REFINERY WASTEWATERS BY FLUORIDE ION CHEMICAL IONIZATION MASS SPECTROMETRY,
Shell Development Co., Houston, TX.
I. Dzidic, A. C. Somerville, J. C. Raia, and H. V. Hart.
Analytical Chemistry ANCHAM, Vol. 60, No. 13, p 1318-1323, July 1, 1988. 9 fig, 4 tab, 16 ref.

Descriptors: *Oil, *Industrial wastewater, *Organic acids, *Water analysis, *Chemical analysis, Mass spectrometry, Naphthenic acids, California.

A method based on negative ion chemical ionization mass spectrometry using fluoride ions produced from NF3 reagent gas was applied to the analysis of naphthenic acids in California crude oils and refinery wastewaters. Since complex mixtures of naphthenic acids cannot be separated into individual components, only the determination of relative distribution of acids classified by the hydrogen deficiency was possible. The identities and relative distribution of paraffinic and mono-, di-, tri-, and higher polycyclic acids were obtained from the intensities of the carboxylate ions. (Author's abstract)
W89-00209

INSTRUMENTATION FOR 7-DAY CONTINUOUS CYCLE MONITORING OF METALS WITH AUTOMATED ON-LINE SAMPLE PREPARATION, HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY, AND ELECTROCHEMICAL DETECTION,
Deakin Univ., Melbourne (Australia). Div. of Chemical and Physical Sciences.
A. M. Bond, W. N. C. Garrard, I. D. Heritage, T. P. Majewski, and G. G. Wallace.
Analytical Chemistry ANCHAM, Vol. 60, No. 13, p 1357-1360, July 1, 1988. 3 fig, 20 ref.

Descriptors: *Monitoring, *Wastewater treatment, *Chromatography, *High performance liquid chromatography, *Heavy metals, *Industrial wastewater, *Chemical analysis, *Water analysis, Automation, Metals.

The design of a new completely automatic high-performance liquid chromatography system with electrochemical detection for on-line monitoring is described. The system can operate continuously for 7 days without maintenance. All procedures are completely automated including sampling from the industrial effluent. This has required the development of a newly designed, low-pressure mixing system, a string bead reactor coil to ensure complete mixing, a bubble chamber to remove bubbles formed during the mixing procedure, and automatic injection of metal complexes. The ex situ method of complex formation has been implemented in an automated version. A heating unit is provided as an option to increase the rate of formation of electroactive metal complexes when reaction rates are slow at ambient temperatures. The potentiostat and electrochemical cell have been integrated into a single unit in a Faraday cage to reduce noise and provide lower detection limits. The flow rate has been decreased to well below 1 ml/min to provide substantial savings of expensive and toxic organic solvent. Microbore chromatography has been introduced so that high resolution is retained at the low flow rates. (Sand-PTT)
W89-00210

INDICATORY ROLE OF SOME INVERTEBRATES FOR QUALITY OF WATER IN THE VISTULA RIVER AND IN SUBSEQUENT STAGES OF ITS TREATMENT,
Polish Academy of Sciences, Lomianki. Inst. Ekologii.
H. Sztrantowicz, and M. Kaniewska-Prus.
Polskie Archiwum Hydrobiologii PAHYA2, Vol. 32, No. 1, p 71-95, 1985. 13 fig, 34 ref.

Descriptors: *Poland, *Vistula River, *Water treatment, *Invertebrates, *Water quality, *Bioindicators, Daphnia, Microorganisms, Microbiological studies, Water chemistry, Reproduction, Seasonal variation, Population dynamics, Physical properties, Pollution load, Rivers, Protozoa, Aquatic habitats, Aquatic plants, Aquatic animals.

Vistula River water is treated for municipal use by the city of Warsaw. The processes of mortality, adaptation, and reproduction were traced in Paramecium aurelia, P. caudatum, and Daphnia magna, along with the physical and chemical properties of the water in which they live, both in the river and before and after treatment at the water-treatment facility. In the case of Protozoa, growth parameters of the population (growth rate, generation time) were examined for the effects of changes in water chemical properties. It was shown that there is a correlation between water quality as calculated by the method of averaged discriminants, and the mortality of test animals. Seasonal and annual changes in mortality of Daphnia magna were also ascertained. The most advantageous environment for the development of protozoan populations was water from the Vistula or from the sedimentation reservoir at the treatment plant (pre-treatment), and for D. magna was water from the 'CQ' container at the plant (post-treatment). It was found that the studied organisms are good bioindicators for aquatic environments with a high degree of chemical pollution. (Alexander-PTT)
W89-00236

IMPACT OF MANGANESE INTOXICATION ON THE BLOOD PYRUVIC ACID OF A FRESHWATER TROPICAL PERCH COLISA FASCIATUS,
Gorakhpur Univ. (India). Dept. of Zoology.
K. Nath, and N. Kumar.
Polskie Archiwum Hydrobiologii PAHYA2, Vol. 34, No. 3, p 347-351, 1987. 1 tab, 26 ref.

Descriptors: *Manganese, *Pyruvic acids, *Toxicity, Blood analysis, *Water pollution effects, *Bioassay, *Toxicity, *Heavy metals, *Bioindicators, *Sublethal effects, Population exposure, Mathematical equations, Metabolites, Fish physiology, Fish, Perch.

The effect of a sublethal concentration (2584 ppm) manganese on the blood pyruvate of Colisa fasciatus was investigated from 3 to 96 h. Blood pyruvic acid level of the fish subjected to manganese exhibited an insignificant decrease up to 12 h; at 24 h an insignificant elevation was apparent. From 48 h onwards a statistically significant elevation was recorded that attained its peak at 96 h. Measurement of carbohydrate metabolites may prove a rapid, simple, and promising means of assessing toxicity of heavy metals and other pollutants to fish. (Author's abstract)
W89-00263

ISOTOPE RATIO MEASUREMENTS OF MO, V, TI, AND ZR AND THE DETERMINATION OF THESE ELEMENTS IN WATER SAMPLES WITH A THERMAL IONIZATION QUADRUPOLE MASS SPECTROMETER (ISOTOPENVERHALTNISMESSUNG VON MO, V, TI AND ZR SOWIE DEREN KONZENTRATIONSBESTIMMUNG IN WASSERN MIT EINEM THERMIONEN-QUADRUPOL-MASSENSPEKTROMETER),
Regensburg Univ. (Germany, F.R.). Inst. fuer Anorganische Chemie.
M. Koppe, and K. G. Heumann.
Fresenius' Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 331, No. 2, p 118-122, June 1988. 2 fig, 4 tab, 33 ref. English summary.

Descriptors: *Mass spectrometry, *Water analysis, *Trace metals, *Analytical methods, *Measuring instruments, *Pollutant identification, Temperature, Performance evaluation, Heavy metals, Molybdenum, Vanadium, Titanium, Zirconium, Isotope studies, Detection limits, Ions, Metals.

Negative MoO3(-) and positive V(+), Ti(+), and Zr(+) thermal ions are produced in a double-filament ion source to determine the isotope ratios of these elements in a quadrupole mass spectrometer. The average relative standard deviation for all isotope ratio measurements is 0.5%. The ratio Me(+)/MeO(+) (Me = V, Ti, Zr) depends on the temperature of the ionization filament. A linear plot is obtained for log (Me(+)/MeO(+)) versus 1/T with increasing Me(+)/MeO(+) ratios for higher temperatures using a single and a double-filament arrangement. An analytical procedure was developed that allows the simultaneous measurement of Mo and V, and of Ti and Zr as well from one filament by a stepwise variation of the filament temperatures. Mo, V, Ti, and Zr traces in the ng/g and pg/g level of different water samples could be analyzed with isotope dilution mass spectrometry using enriched isotopes of 97Mo, 50V, 47Ti, and 91Zr. The precision lies usually in the range of 1 to 6% and the detection limits are 0.002 ng/g for Mo, 0.02 ng/g for V, 0.05 ng/g for Ti, and 0.01 ng/g for Zr using sample amounts of 250 g. (See also W89-00268) (Author's abstract)
W89-00267

CHROMIUM TRACE DETERMINATION IN INORGANIC, ORGANIC AND AQUEOUS SAMPLES WITH ISOTOPE DILUTION MASS SPECTROMETRY (CHROMSPURENBESTIMMUNGEN IN ANORGANISCHEN, ORGANISCHEN UND WABRIGEN PROBEN MIT DER MASSENSPEKTROMETRISCHEN ISOTOPENVERDUNNUNGSANALYSE),
Regensburg Univ. (Germany, F.R.). Inst. fuer Anorganische Chemie.
A. Gotz, and K. G. Heumann.
Fresenius' Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 331, No. 2, p 123-128, June 1988. 1 fig, 4 tab, 34 ref. English summary.

Descriptors: *Chromium, *Analytical methods, *Mass spectrometry, *Measuring instruments, *Pollutant identification, *Sampling devices, *Spectrophotometry, *Spectroscopy, Chromatography, Heavy metals, Isotope studies, Humic acids, Performance evaluation, Tissue analysis, Sediments, Sludge, Soil properties, Detection limits, Ions, Metals.

It is shown that chromium traces in different inorganic, organic and aqueous samples can be determined over a wide concentration range with isotope dilution mass spectrometry. Electrolytic or chromatographic isolation steps are added to a system of sample preparation units for oligo-element determinations to analyze chromium and other heavy metals. The isotope ratio 52Cr/53Cr is measured in a thermal quadrupole mass spectrometer using a single-filament ion source with additions of silica gel and boric acid. In water samples containing humic substances, chromium concentrations of a few ng/g and less can be determined with relative standard deviations of about 1% and better. A differentiation is possible into the total chromium content and into chromium species that carry out isotope exchange reactions and those that are inert for an isotope exchange reaction. The chromium concentrations of four standard reference materials (two plants BCR 60 and 61, one tissue BCR 278, one sewage sludge BCR 144), which are not certified for chromium, were determined to be 29.4 micrograms/g, 534 micrograms/g, 0.78 micrograms/g, and 466.1 micrograms/g, respectively. In three different sediments total chromium concentrations between 100 micrograms/g and 180 micrograms/g are analyzed with relative standard deviations of 0.6%-1.2%. Using aqua regia instead of nitric acid and hydrofluoric acid for the decomposition of sediments, only 60%-90% of the total chromium content is determined. However, the analyzed chromium proportion dissolved in aqua regia is slightly higher when using isotope dilution mass spectrometry compared with other analytical methods. The detection limit is 0.3 pg chromium per g for water samples, 1.8 ng/g for organic substances, and 6 ng/g for materials with high inorganic proportions as for sedi-

ments, sewage sludges and soils. (See also W89-00267) (Author's abstract)
W89-00268

DETERMINATION OF NITRATE AT THE NG/G LEVEL IN ANTARCTIC SNOW SAMPLES WITH ION CHROMATOGRAPHY AND ISOTOPE DILUTION MASS SPECTROMETRY,
Regensburg Univ. (Germany, F.R.). Inst. fuer Anorganische Chemie.
J. Neubauer, and K. G. Heumann.
Fresenius' Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 331, No. 2, p 170-173, June 1988. 3 fig, 4 tab, 15 ref.

Descriptors: *Nitrates, *Hoar frost, *Antarctica, *Snow, *Mass spectrometry, *Ion chromatography, *Analytical methods, *Pollutant identification, Path of pollutants, Firn, Seasonal variation, Cycling nutrients, Isotope studies, Detection limits, Ions, Metals.

Nitrate traces in Antarctic snow and hoar-frost samples, which were collected on the Ekstrom ice shelf during January and February 1987, were determined with ion chromatography. For comparison, sample preparations for isotope dilution mass spectrometry were also carried out in Antarctica with the mass spectrometric measurements taking place in Regensburg, Germany. Comparable reproducibilities of 1%-5% were found for both methods of analyzing nitrate concentrations in the range of 40-190 ng/g. An excellent agreement of the results of both methods with an average deviation of 0.1% was found in three sets of firn core samples. The average relative deviation of the ion chromatographic values from those of isotope dilution mass spectrometry was -10% for eleven hoar-frost and surface snow samples. The highest nitrate concentrations were in hoar-frost samples (average value 548 ng/g). The following order, which corresponds to the age of nitrate depositions, was observed: new snow (206 ng/g), old surface snow (146 ng/g), and snow from firn cores (61 ng/g). The decreasing concentration with the age of samples results re-emission of nitrate into the atmosphere after its deposition by snow. A seasonal variation of the nitrate concentration with a summer maximum and a winter minimum was observed for firn core samples. Accurate results of analytical data can only be guaranteed by the application of independent methods, e.g., by ion chromatography and isotope dilution mass spectrometry, as this work shows. (See also W89-00270) (Author's abstract)
W89-00269

DETERMINATION OF HEAVY METALS AT THE PG/G LEVEL IN ANTARCTIC SNOW WITH DPASV AND IDMS,
Regensburg Univ. (Germany, F.R.). Inst. fuer Anorganische Chemie.
J. Volkening, and K. G. Heumann.
Fresenius' Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 331, No. 2, p 174-181, June 1988. 1 fig, 8 tab, 29 ref.

Descriptors: *Antarctica, *Mass spectrometry, *Voltammetry, *Snow, *Heavy metals, *Analytical methods, *Measuring instruments, *Pollutant identification, Isotope studies, Detection limits, Ions, Lead, Cadmium, Metals, Chromium, Nickel, Copper, Zinc, Iron, Thallium, Sun light.

Differential pulse anodic stripping voltammetry (DPASV) and isotope dilution mass spectrometry (IDMS) were used to analyze heavy metals in Antarctic snow samples. It was possible to determine Pb and Cd with DPASV at the German Antarctic station 'Georg-von-Neumayer' whereas the analyses of Pb, Cd, Tl, Cr, Ni, Cu, Zn, and Fe with IDMS were carried out at the University of Regensburg. 80% of the elemental concentrations in surface snow samples analyzed with IDMS lay in the following ranges: Pb = 3 - 40 pg/g, Cd < 0.2-3 pg/g, Tl < 0.2 pg/g, Cr < 0.8-1.5 pg/g, Ni < 4.8-40 pg/g, Cu < 11-30 pg/g, Zn = 30-500 pg/g, and Fe = 500--1,500 pg/g. In most cases an acceptable agreement between the DPASV and IDMS results was obtained for Pb and Cd. More than 50% of all Pb analyses agreed within a deviation of 0-10 pg/g. The Cd results between both methods usually deviated by less than 1 pg/g. Slightly higher Pb concentrations were analyzed on average with IDMS compared with DPASV. This effect was not observed for the Cd data. A possible explanation for this fact are non-ionic Pb species in the melted snow samples, which cannot be analyzed by DPASV. One particular investigation of Pb concentrations showed that the analyzed data with DPASV decreased with the increasing length of sunshine after a snowfall when samples of the same origin were determined. Blank control is the major requirement for accurate analysis results of heavy metals in this low concentration range. On the other hand, accuracy must always be tested by independent analytical methods. In this work it is shown that Pb and Cd can be analyzed directly in the Antarctic with DPASV and that the results of this method are in acceptable agreement with the definitive method, IDMS. (See also W89-00269) (Author's abstract)
W89-00270

WOUND FIBERGLASS DEPTH FILTERS AS A LESS EXPENSIVE APPROACH FOR THE CONCENTRATION OF VIRUSES FROM WATER,
Institut Armand-Frappier, Laval (Quebec). Centre de Recherche en Virologie.
P. Payment, and M. Trudel.
Canadian Journal of Microbiology CJMIAZ, Vol. 34, No. 3, p 271-272, March 1988. 1 tab, 7 ref.

Descriptors: *Viruses, *Fiberglass filters, *Microscopic analysis, *Pollutant identification, *Sampling devices, Performance evaluation, Hydrogen ion concentration, Chemical treatment, Rivers, Surface water, Cost analysis, Filters.

Wound fiberglass depth cartridge filters (25.4 cm) with a nominal porosity of 1 micron were used to concentrate viruses from large volumes of surface water. They were found to be an excellent, less expensive alternative to the 0.2-micron pleated cartridge filters normally used for the concentration of enteric viruses from water. More than 99% of experimentally seeded poliovirus was adsorbed to these filters when the pH of the water was adjusted to pH 3.5 and aluminum chloride was added to a final concentration of 0.001 M, as recommended for electronegative filters. In comparative recovery of indigenous viruses from river water, similar results were obtained with two 1-micron or a 3-micron + 0.2-micron filter combination. The cost of the two 1-micron filters is about Can. $26, while it is about Can. $58 for the other combination. (Author's abstract)
W89-00279

ANALYSIS OF PPB LEVELS OF ORGANICS IN WATER BY MEANS OF PURGE-AND-TRAP, CAPILLARY GAS CHROMATOGRAPHY AND SELECTIVE DETECTORS,
HNU Systems, Inc., Newton, MA.
M. Duffy, J. N. Driscoll, S. Pappas, and W. Sanford.
Journal of Chromatography JOCRAM, Vol. 441, No. 1, p 73-80, May 27, 1988. 7 fig, 7 ref.

Descriptors: *Organic compounds, *Gas chromatography, *Chemical analysis, *Water analysis, *Pollutant identification, Water quality control, Drinking water, Conductivity, Photoionization, Volatile organic compounds.

The Environmental Protection Agency (EPA) has issued a series of methods (500 and 600 series) for the analysis of organics in drinking water and industrial discharges. Methods 601 and 602 employ packed-column gas chromatography (GC) with electrolytic conductivity (ElCD) and photoionization detection (PID). A purge-and-trap system is used for concentration of volatiles. The EPA is in the process of converting methods 601 and 602 and certain 500-series methods to capillary column analysis. The conversion of a number of these methods, using ElCD and PID is described in detail. Both 0.32- and 0.53-mm diameter capillary columns, using helium and nitrogen as carrier gases with each detector were evaluated. With nitrogen, optimum results were obtained at a flow-rate of 15 ml/min, and with helium at 6-8 ml/min. As a result of system optimization, including operation of the two detectors in series, and converting from packed to capillary columns, analysis time could be reduced from 80 min (for two methods separately) to 30 min. In addition, the elution of more than five components in one peak, observed when the packed column specified in method 601 is used, was eliminated. (Author's abstract)
W89-00288

PERIPHYTON, BENTHIC INVERTEBRATES AND FISHES AS BIOLOGICAL INDICATORS OF WATER QUALITY IN THE EAST BRANCH BRANDYWINE CREEK,
Pennsylvania Dept. of Environmental Resources, Norristown.
D. F. Knorr, and G. W. Fairchild.
Proceedings of the Pennsylvania Academy of Science PPSAK, Vol. 61, No. 1, p 61-66, 1987. 3 fig, 5 tab, 15 ref.

Descriptors: *Bioindicators, *Water pollution effects, *Periphyton, *Benthic environment, *Macroinvertebrates, *Fish, Brandywine Creek, Water quality, Monitoring, Aquatic insects, Streams, Water pollution effects.

Three groups of stream organisms - periphyton, benthic macroinvertebrates and fish - were examined in relation to changing physicochemical conditions in the East Branch Brandywine Creek and its tributary Marsh Creek, Chester County, PA to compare their potential as biological indicators of water quality. Sampling was performed during July-August 1985. Periphyton standing crop varied among sites from 7-21 micrograms chlorophyll-a/sq cm of artificial substrate surface, showing evidence of nutrient limitation only below Marsh Creek Reservoir. Surber samples of benthic invertebrates were numerically dominated by filter feeding aquatic insects (fam. Hydropsychidae and Simuliidae) at all sites. The three biotic assemblages studied all showed site-specific differences, clearly indicating changing environmental conditions within the study area. Relatively little of this variation, however, was directly associated with the pronounced increase in ambient nutrients. The slight decline in macroinvertebrate taxon richness at site 4 provided perhaps the best evidence of habitat modification below Downingtown, and taxon richness was quickly restored at site 5 despite continued high nutrient levels. This does not diminish the worth of the biota in stream monitoring. Indeed, all three groups showed striking responses of the very different conditions provided at site 2 below Marsh Creek Reservoir. (Lantz-PTT)
W89-00314

DEVELOPMENTAL DEFECTS IN PELAGIC FISH EMBRYOS FROM THE WESTERN BALTIC,
Biologische Anstalt Helgoland (Germany, F.R.)
For primary bibliographic entry see Field 5C.
W89-00315

APPLICATION AND TESTING OF AN INDEX OF BIOTIC INTEGRITY IN SMALL, COOL-WATER STREAMS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Fisheries and Wildlife Sciences.
For primary bibliographic entry see Field 2H.
W89-00323

NOVEL APPROACH FOR MODIFYING MICROPOROUS FILTERS FOR VIRUS CONCENTRATION FROM WATER,
Florida Univ., Gainesville. Dept. of Microbiology and Cell Science.
D. R. Preston, T. V. Vasudevan, G. Bitton, S. R. Farrah, and J.-L. Morel.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 6, p 1325-1329, June 1988. 1 fig, 7 tab, 14 ref.

Descriptors: *Filter media, *Filters, *Viruses, *Adsorption, Polymers, Enteroviruses, Coxsackie

virus, Coliphage, Ionization, Sampling devices, Secondary wastewater.

Electronegative microporous filters composed of epoxyfiberglass (Filterite) were treated with cationic polymers to enhance their virus-adsorbing properties. This novel and inexpensive approach to microporous filter modification entails soaking filters in an aqueous solution of a cationic polymer such as polyethyleneimine (PEI) for 2 h at room temperature and then allowing the filters to air dry overnight on absorbent paper towels. PEI-treated filters were evaluated for coliphage (MS2, T2, and Phi X174) and enterovirus (poliovirus type 1 and coxsackie virus type B5) adsorption from buffer at pH 3.5 to 9.0 and for indigenous coliphages from unchlorinated secondary effluent at ambient pH. Adsorbed viruses were recovered with 3 % beef extract (pH 9). Several other cationic polymers were used to modify epoxyfiberglass filters and were evaluated for their ability to concentrate viruses from water. Zeta potentials of disrupted filter material indicated that electronegative epoxyfiberglass filters were made more electropositive when treated with cationic polymers. In general, epoxyfiberglass filters treated with cationic polymers were found to adsorb a greater percentage of coliphages and enteroviruses than were untreated filters. (Author's abstract)
W89-00332

NATIONAL FIELD EVALUATION OF A DEFINED SUBSTRATE METHOD FOR THE SIMULTANEOUS ENUMERATION OF TOTAL COLIFORMS AND ESCHERICHIA COLI FROM DRINKING WATER: COMPARISON WITH THE STANDARD MULTIPLE TUBE FERMENTATION METHOD,
Yale Univ., New Haven, CT. School of Medicine.
S. C. Edberg, M. J. Allen, and D. B. Smith.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 6, p 1595-1601, June 1988. 1 fig, 6 tab, 23 ref.

Descriptors: *Field tests, *Autoanalyzers, *Substrates, *Coliforms, *Escherichia coli, Drinking water, Indicator nutrients, Multiple tube fermentation, Fluorescence, Performance evaluation, Fermentation, Population density, Comparison studies.

A defined substrate method was developed to simultaneously enumerate total coliforms and Escherichia coli from drinking waters without the need for confirmatory or completed tests. A hydrolyzable substrate as a specific indicator-nutrient for the target microbes. No equipment other than a 35 C incubator and long-wavelength (366-nm) light is necessary. To perform the test, water is added to the powdered ingredients in a tube or flask. If total coliforms are present in the water sample, the solution will change from its normal colorless state to yellow. The specific presence of E. coli will cause the same tube to fluoresce under a longwave (366-nm) UV lamp. The test, called Autoanalysis Colilert (AC), was compared with Standard Methods for the Examination of Water and Wastewater 10-tube multiple tube fermentation (MTF) in a national evaluation. Five utilities, representing six U.S. Environmental Protection Agency regions, participated. All water samples came from distribution systems. Split samples from a wide variety of water sources were analyzed for the most probable number (MPN)-versus-MPN comparison. A total of 1,086 tubes were positive by MTF, and 1,279 were positive by AC. There was no statistical difference between MTF and AC. Species identifications from positive tubes confirmed the sensitivity of the AC. The national evaluation of the AC test showed that is: (1) was as sensitive as Standard Methods MTF, (2) specifically enumerated 1 total coliform, per 100 ml, in an maximum of 24 h, (3) simultaneously enumerated 1 E. Coli per 100 ml in the same analysis, (4) was not subject to false-positive or false-negative results by heterotrophic bacteria, (5) didn't require confirmatory tests, (6) grew injured coliforms, (7) was easy to inoculate, and (8) was very easy to interpret. (Author's abstract)
W89-00337

EFFICACY OF CHEMICAL DOSING METHODS FOR ISOLATING NONTUBERCULOUS MYCOBACTERIA FROM WATER SUPPLIES OF DIALYSIS CENTERS,
Center for Infectious Diseases, Atlanta, GA. Hospital Infections Program.
L. A. Carson, L. B. Cusick, L. A. Bland, and M. S. Favero.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 7, p 1756-1760, July 1988. 5 tab, 34 ref.

Descriptors: *Isolation, *Separation techniques, *Mycobacterium, *Bacterial analysis, *Analytical methods, *Pollutant identification, *Bacteria, *Dialysis centers, *Chemical treatment, Water treatment, Formaldehyde.

Investigations of nontuberculous mycobacterium (NTM) infections associated with various environmental sources have been hampered by the lack of adequate techniques for selective isolation of these organisms from environmental fluids. This study compared chemical dosing techniques for recovery of NTM from water samples collected from 115 randomly selected dialysis centers. Cell suspensions of NTM group II and IV isolates and gram-negative bacteria were exposed to solutions containing sodium hypochlorite (0.2 micrograms/mL of free available chlorine), formaldehyde (1, 0.75, or 0.5%), oxalic acid (1.25%), cetylpyridinium chloride (25 micrograms/mL), or cetyltrimethylammonium bromide (100 micrograms/mL). Results of standard membrane filtration assays with laboratory test strains and water samples from dialysis centers showed that 5 min of exposure to 1% formaldehyde effectively reduced gram-negative bacterial populations and allowed increased recovery of NTM in environmental fluids containing mixed populations. (Author's abstract)
W89-00343

METHODS FOR DETERMINATION OF SUM PARAMETERS AND CHARACTERIZATION OF ORGANOCHLORINE COMPOUNDS IN SPENT BLEACH LIQUORS FROM PULP MILLS AND WATER, SEDIMENT AND BIOLOGICAL SAMPLES FROM RECEIVING WATERS,
Senter for Industriforskning, Oslo (Norway).
K. Martinsen, A. Kringstad, and G. E. Carlberg.
Water Science and Technology WSTED4, Vol. 20, No. 2, p 13-24, 1988. 5 fig, 4 tab, 15 ref.

Descriptors: *Chlorinated hydrocarbons, *Bleaching wastes, *Pollutant identification, *Wastewater analysis, *Water analysis, *Tissue analysis, Chlorine, Hydrocarbons, Wastes, Industrial wastes, Pulp and paper industry, Chemical analysis, Neutron activation analysis, Sample preparation, Sediments, Fish, Solvents, Adsorption, Detection limits, Chromatography, Thin layer chromatography, Sulfuric acid.

Methods were optimized for the determination of extractable organic chlorine in water, sediment, and fish. Cyclohexane was found to be the best nonpolar extraction solvent. For sediment and fish samples, a cyclohexane/isopropanol solvent mixture was used. The organic chlorine in the extracts was determined by neutron activation analysis. The precision of the methods varied between 1 and 11% over a large concentration interval. Two methods for determination of adsorbable organic halogen using carbon and XAD-4 as adsorbents were compared. The carbon adsorption method had a lower detection limit (3 micrograms/l) and gave higher concentrations for seawater samples. Examples of treatment with sulfuric acid containing different amounts of water and the use of thin layer and gel permeation chromatography to separate and characterize extractable organic chlorine are shown. (Author's abstract)
W89-00358

HIGH MOLAR MASS LIGNIN IN BLEACHED KRAFT PULP MILL EFFLUENTS,
Finnish Pulp and Paper Research Inst., Helsinki.
P. E. Sagfors, and B. Starck.
Water Science and Technology WSTED4, Vol. 20, No. 2, p 49-58, 1988. 4 fig, 5 tab, 6 ref.

Descriptors: *Lignin, *Bleaching wastes, *Pulp wastes, *Wastewater analysis, Effluents, Wastes, Industrial wastes, Chromatography, Carbohydrates, Sample preparation, Chemical analysis, Pollutant identification, Toxicity, Daphnia, Crustaceans, Spectroscopy, Infrared.

The proportion of high molar mass (M > 1,000 dalton) substances (HMM) in acid and alkaline bleaching effluents from kraft pulping was studied by analytical gel permeation chromatography, GPC. The amount of HMM substances in alkaline effluents was 65-75% and in acid stage effluents 20% of the UV-absorbing components. Lignin is the precursor of the HMM substances in the alkaline stage, and lignin and carbohydrates are the precursors of the acid stage HMM substances. The infrared spectra of both alkaline and acid stage substances in their neutral form had strong bands characteristic of carboxylic salts. In the spectra of hardwood substances, a narrow aromatic band of low intensity was found in two alkaline stage HMM samples originating from mills using a high proportion of ClO2 to chlorine. The chlorine content was as high as 9.8% when the ClO2 charge had been small and less than 4% with a large ClO2 charge. The low methoxyl group content and high oxygen content showed that the substances were largely oxidized. The LC50 test with Daphnia indicated no acute toxicity. (Author's abstract)
W89-00361

FATE OF SPENT BLEACH LIQUOR MATERIAL IN RECEIVING WATERS: CHARACTERIZATION OF CHLOROORGANICS IN SEDIMENTS,
Svenska Traeforskningsinstitutet, Stockholm.
For primary bibliographic entry see Field 5B.
W89-00371

DETERMINATION OF MONO- AND DIVALENT CATIONS AND ANIONS IN SMALL FOG SAMPLES BY ION CHROMATOGRAPHY,
Paul Scherer Inst., Wuerenlingen (Switzerland).
U. Baltensperger, and S. Kern.
Journal of Chromatography JOCRAM, Vol. 439, No. 1, p 121-127, May 6, 1988. 2 fig, 2 tab, 14 ref.

Descriptors: *Pollutant identification, *Cations, *Anions, *Fog, *Chemical analysis, *Chromatography, Organic compounds, Inorganic compounds, Filtration, Hydrogen ion concentration, Sulfites, Acid rain, Water analysis.

The application of ion chromatography to the determination of inorganic and organic anions and mono- and divalent cations in fog samples with a total volume of 1 ml, is described. After filtration, the samples were split for four different ion chromatographic injections, all by autosampler. Detection limits were below 20 ppb for all ions. The pH was determined by means of a micro pH meter. The calculated ion balances agreed to within 16% or better in all instances. Adding glycerine did not enhance the stability of sulfite during sampling but enhanced the stability of sulfite in fog samples against oxidation by hydrogen peroxide in laboratory experiments. (Author's abstract)
W89-00372

FECAL COLIFORM FINGERTIP COUNT: A POTENTIAL METHOD FOR EVALUATING THE EFFECTIVENESS OF LOW COST WATER SUPPLY AND SANITATION INITIATIVES,
Leeds Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W89-00379

EVALUATING THE MODIFICATIONS TO THE MF TOTAL COLIFORM METHOD FOR DRINKING WATER WITH HIGH NONCOLIFORM BACKGROUNDS,
Wisconsin State Lab. of Hygiene, Madison.
J. H. Standridge, and W. C. Sonzogni.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 6, p 90-91, June 1988. 1 tab, 5 ref.

Descriptors: *Culturing techniques, *Bacterial analysis, *Coliforms, *Drinking water, Microbiological studies, Anaerobic conditions.

A method involving anaerobic incubation of membrane filtration (MF) cultures for total coliform analysis of drinking water is evaluated and contrasted with swab inoculation of overgrown cultures to brilliant green bile broth. The anaerobic incubation technique resulted in the unmasking of many coliform organisms that would have been missed in the standard technique because of overgrowth. Many coliform organisms failed to test positive, however, when incubated anaerobically. The swab inoculation technique and the anaerobic technique unmasked similar percentages of coliform-positive samples. (Author's abstract)
W89-00427

RAPID SPECIFIC ENVIRONMENTAL COLIFORM MONITORING,
Access Medical Systems, Branford, CT. Analytical Systems Div.
S. Stratman.
American Laboratory ALBYBL, Vol. 20, No. 7, p 60-64, July 1988. 4 fig, 2 tab, 8 ref.

Descriptors: *Coliforms, *Drinking water, *Water analysis, *Bacterial analysis, Pollutant identification, Bacteria, Potable water, Public health, Reagents, Technology, Sampling, Enzymes.

The current technique for coliform testing of drinking water has several major drawbacks. They are: the time required to generate confirmed positive results (up to five days); the subjective nature of results interpretation; the complicated, lengthy, and labor-intensive test setup procedures (washing, sterilizing, media preparation, quality control, etc); and the susceptibility to interference by noncoliform, heterotrophic bacteria. A new technique for coliform testing that overcomes these problems is described. This reagent, a predispensed, dry blended formulation consisting of salts, nitrogen, carbon sources and specific indicator nutrients, drives the metabolism of the target microbes total coliforms and E. coli toward the indicator nutrients ONPG and MUG, respectively. At the same time, noncoliform, heterotrophic bacteria are chemically suppressed. The mechanism of a positive reaction involves the specific indicator nutrient substrates in the reagent matching specific constituitive enzymes (enzymes that are always present in the bacterium) are unique to coliforms and E. coli. Presence of coliforms in the reagent-sample water mixture is indicated by a yellow color. Results of nationwide trials across 10 geographically diverse sites showed the reagent of be equivalent to standard methods in sensitivity and specificity of coliform detection. (Friedmann-PTT)
W89-00445

PURGE AND TRAP ANALYSIS OF AQUEOUS SAMPLES WITH CRYOFOCUSING,
Chemical Data Systems, Oxford, PA.
J. W. Washall, and T. P. Wampler.
American Laboratory ALBYBL, Vol. 20, No. 7, p 70-74, July 1988. 8 fig, 1 tab, 4 ref.

Descriptors: *Pollutant identification, *Water analysis, *Chromatography, *Organic compounds, *Volatile organic compounds, Capillary water, Volatile acids.

Major improvements in the design of purge and trap analysis systems have centered on the development of capillary columns suitable for the analysis, and on better ways of interfacing the trap to capillary chromatographs. Application of the method to volatile organics purged from 5 mL water samples using a model 330 sample concentrator, equipped with a liquid nitrogen cryogenic refocuser, with chromatography and a variety of wide bore columns and narrow bore columns is reviewed. Analysis of the aqueous samples showed good reproducibility for all organic compounds studied. The introduction of capillary methods for the analysis of volatile pollutants has enhanced the sensitivity and resolution of the technique, and has provided a means to shorten the analysis time. (Friedmann-PTT)
W89-00446

RAIN ACIDITY IN STELLENBOSCH,
M. Bohm.
South African Journal of Science SAJSAR, Vol. 81, No. 11, p 652-654, November/December 1985. 5 tab, 6 ref.

Descriptors: *Sampling, *Acid rain, *Stellenbosch, *Water pollution sources, *South Africa, Hydrogen ion concentration, Sulfuric acid, Nitric acid, Hydrochloric acid, Acetic acid, Formic acid.

An acid rain sampling instrument built by the Electricity Supply Commission of South Africa (Escom) was tested under field conditions at the Jonkershoek Forestry Research Center near Stellenbosch from June to August 1983. In addition, a few storms were specifically sampled for analysis of strong-acid anions to determine if the region received acid rain. Free acidity in precipitation may be caused by various proton donors: strong acids (e.g., sulfuric, nitric and hydrochloric acids), weak organic acids (e.g., acetic and formic acids) or metal oxides (e.g., aluminum and iron oxides). From the data presented, however, it can be inferred that the rain falling over this area was relatively unpolluted with respect to sulfate and nitrate. It should be noted that for the rain event with the lowest pH (4.95), the free acidity was not due to anthropogenically produced strong-acid anions. This illustrates the danger of referring to acid rain as rain water which, first, is acidic and second has a pH value below 5.6. Without knowing the chemistry of the rain water, and in particular the sulfate and nitrate concentrations, no conclusions on 'acid rain' can be drawn. (Lantz-PTT)
W89-00454

DETERMINATION OF FREE CYANIDE IN WATER BY RELEASED FLUORESCENCE OF A DISSOCIATED TERNARY COMPLEX,
Wuhan Univ. (China). Dept. of Chemistry.
Q. Yin, and C.-N. Ho.
Analytical Letters ANALBP, Vol. 21, No. 7, p 1297-1304, July 1988. 1 fig, 2 tab, 15 refs.

Descriptors: *Pollutant identification, *Cyanide, *Fluorescence, *Water analysis, *Fluorometry, Metal complexes, Water quality, Toxicity, Silver, Detection limits.

It is important to monitor the amount of cyanide present in the environment because it is toxic at very low levels. A fluorometric procedure for the analysis of free cyanide is based on the dissociation of a ternary complex of silver-1,10-phenanthrolinetetrabromofluorescein by cyanide to produce a fluorescent product. The fluorescence intensity was found to be directly proportional to the cyanide concentration. The method can reliably detect 0.02 microg/ml cyanide. (Author's abstract)
W89-00477

SIMULTANEOUS GAS CHROMATOGRAPHIC DETERMINATION OF NITROBENZENE AND 2,4-DINITROPHENOL IN NITROBENZENE MANUFACTURING PLANT WASTEWATER,
Institute of Science, Bombay (India). Dept. of Analytical Chemistry.
S. S. Patil, and V. M. Shinde.
Analytical Letters ANALBP, Vol. 21, No. 8, p 1397-1408, August 1988. 4 fig, 4 tab, 12 ref.

Descriptors: *Pollutant identification, *Wastewater treatment, *Gas chromatography, *Water analysis, *Benzenes, *Phenols, *Chemical wastes, Nitrogen compounds, Nitrobenzene, Dinitrophenol.

A simple and rapid procedure is described for the identification and quantification of pollutants in nitrobenzene manufacturing wastewater. The samples were extracted with methylene chloride; nitrobenzene and 2,4-dinitrophenol were determined by gas chromatography using a flame ionization detector. The method was found to be precise, accurate, and applicable for monitoring effluent treatment systems at ppm levels. (Author's abstract)
W89-00479

DETERMINATION OF COBALT IONS IN NATURAL WATERS USING DIFFERENTIAL PULSE ADSORPTIVE STRIPPING VOLTAMMETRY,
Academia Sinica, Qingdao (China). Inst. of Oceanology.
Z. Hao, J.-C. Vire, G. J. Patriarche, and R. Wollast.
Analytical Letters ANALBP, Vol. 21, No. 8, p 1409-1424, August 1988. 8 fig, 1 tab, 23 ref. SPPS (Belgium Politic Research, ARC) Contract 86/91-89.

Descriptors: *Pollutant identification, *Voltammetry, *Water analysis, *Cobalt, *Differential pulse adsorptive stripping voltammetry, Natural waters, Chemical analysis, Measuring instruments, Ions, Metal complexes, Detection limits, Estuaries, Salinity, Sample preparation, Filtration, Ultraviolet radiation, Hydrogen ion concentration.

Differential pulse adsorptive stripping voltammetry (DPASV) using dimethylglyoxime complexes in the presence of triethanolamine and ammonium chloride was applied to the determination of cobalt(++) ions and found to be highly sensitve. The limit of detection was about 3 ppt. Actual analyses of estuary water are reported. Three locations were selected in different salinity regimes. Four types of water samples were analyzed: (1) filtered; (2) filtered, UV-irradiated; (3) unfiltered, acidified; and (4) acidified, UV-irradiated. The cobalt concentrations of irradiated filtered samples were higher than filtered ones. If the water sample was not filtered and only acidified to pH about 2, cobalt was desorbed from the surface of particulate matter and most of the organic complexes were broken down to release cobalt as an ionic species. The results of acidified samples and irradiated acidified samples indicated that the UV-irradiation treatment had no influence on the determination of cobalt. The method provides a feasible approach for determination of cobalt in natural waters. (Shidler-PTT)
W89-00480

INDIRECT TRACE DETERMINATION OF ETHYLENEDIAMINETETRAACETIC ACID (EDTA) IN WATER BY POTENTIOMETRIC STRIPPING ANALYSIS,
Jordan Univ., Amman. Analytical Chemistry Labs.
M. Fayyad, M. Tutunji, and Z. Taha.
Analytical Letters ANALBP, Vol. 21, No. 8, p 1425-1432, August 1988. 7 tab, 8 ref.

Descriptors: *Pollutant identification, *Ethylenediaminetetraacetic acid, *Ion-selective electrodes, *Trace levels, *Potentiometric stripping analysis, Chemical analysis, Bismuth, Metal complexes, Hydrogen ion concentration, Electrodes, Potentiometric level, Standard deviation, Detection limits.

An analytical method for determination of ethylenediaminetetraacetic acid (EDTA) is described. Excess Bi(+++) was added to form a 1:1 complex with EDTA at pH 2.3. The uncomplexed Bi(+++) was then deposited on a glassy carbon electrode at a potential of -0.40 V and subsequently stripped potentiometrically using potassium dichromate as oxidant. The stripping time of uncomplexed Bi(+++) was recorded. The concentration of EDTA in the sample was determined from the concentration of added Bi(+++) and the potentiometrically stripped Bi(+++) at -0.4 V by the standard addition method. The relative standard deviations for EDTA concentrations of 95 ppb and 4.5 ppb were 1.9% and 2.6%. The detection limit was about 1 ppb EDTA for a deposition time of 3 minutes. (Author's abstract)
W89-00481

DETERMINATION OF TRACES OF BISMUTH IN WATER WITH POLYURETHANE FOAM THIN-LAYER SPECTROPHOTOMETRY,
National Research Centre, Cairo (Egypt). Microanalytical Research Lab.
Y. A. Gewargious, M. N. Abbas, and H. N. A. Hassan.
Analytical Letters ANALBP, Vol. 21, No. 8, p 1477-1486, August 1988. 5 fig, 2 tab, 9 ref.

Descriptors: *Pollutant identification, *Bismuth, *Trace metals, *Water analysis, *Spectrophotometry, *Polyurethane-foam thin-layer spectrophotometry, Chemical analysis, Sorption, Metal complexes, Trace levels.

A bismuth determination method uses polyether polyurethane foam sorbent as a matrix. Sorption of the bismuth iodide complex into the foam thin layer resulted in a substantial improvement of the measured absorbance value of colored species. The average recovery amounted to 105.25%. These results are considered quite satisfactory for trace-level analysis. (Author's abstract)
W89-00482

HEAD-SPACE ANALYSIS OF READILY VOLATILE CHLORINATED HYDROCARBONS IN AIR AND WATER (HEAD-SPACE-ANALYTIK LEICHTFLUECHTIGER CHLORKOHLENWASSERSTOFFE IN LUFT UND WASSER),
Bundesanstalt fuer Gewaesserkunde, Koblenz (Germany, F.R.).
H. Hellmann.
Zeitschrift fuer Wasser und Abwasser-Forschung ZWABAQ, Vol. 21, No. 2, p 67-72, April 1988. 8 fig, 9 tab, 10 ref.

Descriptors: *Pollutant identification, *Chlorinated hydrocarbons, *Head-space analysis, *Air pollution, *Water pollution, Atmosphere, Pollutants.

By the aid of head-space analysis readily volatile chlorinated hydrocarbons can also be determined simply in air samples. Sample preparation is not necessary, nor is sample enrichment. Depending on circumstances, the injection time must be increased from 1 to 4-9 sec. What is needed is a detection-sensitive electron-trapping detector. The method could be developed further by improving the analysis apparatus. (Author's abstract)
W89-00504

DETERMINATION OF TRACE CHROMIUM IN NATURAL WATER BY POLAROGRAPHIC CATALYTIC WAVE ANALYSIS, (IN CHINESE),
S. Xunrong, H. Lijuan, and Y. Sunkai.
Oceanologia et Limnologia Sinica OECOBX, Vol. 18, No. 3, p 280-285, May 1987. 8 fig, 5 tab, 9 ref. English summary.

Descriptors: *Chromium, *Trace metals, *Chemical analysis, *Polarography, *Water analysis.

The polarographic catalytic wave of trace chromium in natural waters and its mechanism were studied. In the ammonium acetate and cupferron system, a clear, sensitive and stable catalytic wave is obtained, and its largest peak potential on the differential oscilloscopic polarogram is -1.02 V. The peak height was proportional to the concentration of chromium (VI) in the range of 2 to the minus 9th power to 0.000001 g/mL. It is unnecessary to separate and preconcentrate natural water samples that can be directly detected. (Author's abstract)
W89-00538

LIGNIN RESIDUES AS TRACERS OF ORGANIC WASTE TRANSPORT,
Gulf Coast Research Lab., Ocean Springs, MS.
For primary bibliographic entry see Field 7B.
W89-00561

PRECONCENTRATION OF HEAVY METALS IN NATURAL WATERS WITH HYDRAZONES SUPPORTED ON SILICA GEL,
Thessaloniki Univ., Salonika (Greece). Lab. of Analytical Chemistry.
C. Samara, and T. A . Kouimtzis.
Chemosphere CMSHAF, Vol. 16, Nos. 2/3, p 405-416, 1987. 2 fig, 5 tab, 11 ref.

Descriptors: *Pollutant identification, *Water analysis, *Heavy metals, Metals, Hydrazones, Trace elements, Cobalt, Copper, Zinc, Cadmium, Nickel, Lead.

A new hydrazone (2,2'-dipyridyl-4-amino-3-hydrazino-5-mercapto-1,2,4 triazolehydrazone) supported on silica gel was used as a preconcentration step for determination of heavy metals in natural waters. Copper, zinc, lead, cadmium, and nickel were quantitatively eluted from the column with 0.1 M EDTA, while cobalt was eluted with 2 M perchloric acid. Measurement was by atomic absorption spectrophotometry. Analyses of tap water, lake water and seawater showed results comparable with independent methods. (Cassar-PTT)
W89-00568

APPLICATION OF HEADSPACE GAS CHROMATOGRAPHY TO THE MONITORING OF ORGANIC SUBSTANCES IN INDUSTRIAL EFFLUENT,
BASF A.G., Ludwigshafen am Rhein (Germany, F.R.). Aktiengesellschaft labor fuer Umweltanalytik und Okologie.
W. Merz, and H. J. Neu.
Chemosphere CMSHAF, Vol. 16, Nos. 2/3, p 469-484, 1987. 5 fig, 4 ref.

Descriptors: *Pollutant identification, *Wastewater analysis, *Water analysis, *Industrial wastewater, *Effluents, *Chromatography, Gas chromatography, Organic compounds, Trace levels, Volatile organics.

A double-capillary headspace gas chromatograph was used in the analysis of industrial effluents containing low levels of organic solvents, including volatile matter. The advantages of this method over conventional extraction techniques include (1) no interfering solvent peak, (2) simple and rapid sample preparation, (3) nonvolatile compounds do not reach the separating system, (4) water containing suspended solids can also be analyzed, and (5) detection limits in the ppb range can be reached. Among the compounds in the study were toluene, aniline, and diphenyl ether. (Cassar-PTT)
W89-00572

HIGH RESOLUTION EMISSION SPECTROSCOPY (SHPOL'SKII EFFECT): A NEW ANALYTICAL TECHNIQUE FOR THE ANALYSIS OF POLYCYCLIC AROMATIC HYDROCARBONS (PAH) IN THE ENVIRONMENTAL SAMPLES,
Bordeaux-1 Univ., Talence (France). Groupe d'Oceanographie Physicochimique.
P. Garrigues, and M. Ewald.
Chemosphere CMSHAF, Vol. 16, Nos. 2/3, p 485-494, 1987. 3 fig, 2 tab, 22 ref.

Descriptors: *Pollutant identification, *Spectroscopy, *Aromatic compounds, *Spectrofluorometry, *Polycyclic aromatic hydrocarbons, Hydrocarbons, Organic compounds, Phenanthrene, Chrysene, Sediments.

High resolution spectrofluorometry (HRS) in n-alkane matrices (Shpol'skii effect) was used for the analysis of several polycyclic aromatic hydrocarbons in aquatic sediments, aerosols, and crude oils. The samples were fast frozen at 77 K in liquid nitrogen to sharpen the luminescent spectra. It was possible to differentiate between phenanthrene and methylphenanthrene and between chrysene and methylchrysene. The ratios of the methyl compound to the parent compound indicate the source of the polycyclic aromatics, lower ratios being associated with high temperature combustion. (Cassar-PTT)
W89-00574

DETERMINATION OF PHENOXY ACID HERBICIDES IN WATER SAMPLES,
Gesamthochschule Paderborn (Germany, F.R.). Dept. of Applied Chemistry.
R. Hamann, and A. Kettrup.
Chemosphere CMSHAF, Vol. 16, Nos. 2/3, p 527-536, 1987. 5 fig, 2 tab, 10 ref.

Descriptors: *Pollutant identification, *Water analysis, *Pesticides, *Herbicides, 2,3,5-T, 2,4-D, Chromatography.

Two HPLC methods were developed for trace analysis of phenoxy acid herbicides in the ranges 1 ppb to 1 ppm and 20 ppt to 1 ppb using spiked water samples. Sample preparation was by liquid-liquid extraction with methylene chloride. For the 1 ppb-1ppm range on-line enrichment with a methanolic solution was performed. In the lower concentration range the methylene chloride extract was preconcentrated in a solid-phase cartridge filled with an amino phase, followed by on-line enrichment. Detection was carried out by ultraviolet at 280 and 230 nm. Herbicide materials investigated were 2,4,5-trichlorophenoxyacetic acid, 2,4-dichlorophenoxyacetic acid, MCPA (4-chloro-2-methylphenoxyacetic acid), 2-(2,4,5-trichlorophenoxy)-propionic acid, 2-(2,4-dichlorophenoxy)-propionic acid, MCPP (2-(4-chloro-2-methylphenoxy)-propionic acid), 4-(2,4-dichlorophenoxy)-butyric acid, MCPB (4-(4-chloro-2-methylphenoxy)-butyric acid, and Dicamba (2-methoxy-3,6-dichlorobenzoic acid). (Cassar-PTT)
W89-00576

ASSOCIATION BETWEEN SEAWATER POLLUTION AS MEASURED BY BACTERIAL INDICATORS AND MORBIDITY AMONG BATHERS AT MEDITERRANEAN BATHING BEACHES OF ISRAEL,
Hebrew Univ. of Jerusalem (Israel). School of Public Health.
For primary bibliographic entry see Field 5C.
W89-00579

COORDINATED PROGRAMME FOR RESEARCH AND MONITORING OF POLLUTION IN THE MEDITERRANEAN,
United Nations Environment Programme, Athens (Greece). Co-ordinating Unit for the Mediterranean Action Plan.
F. Saverio Civili, and L. Jeftic.
Chemosphere CMSHAF, Vol. 16, Nos. 2/3, p 633-649, 1987. 5 tab, 17 ref.

Descriptors: *Water pollution sources, *Monitoring, *Path of pollutants, *Mercury, *Mediterranean Sea, MED POL program, Coastal waters, Heavy metals, Metals, Bacteria, Organic compounds, Nitrogen, Suspended solids, Nitrogen, Phosphorus, Invertebrates, Benthic fauna, Estuaries.

The MED POL program (Joint Coordinated Pollution Monitoring and Research Program in the Mediterranean) Phase II is scheduled to monitor pollution in the Mediterranean during 1981 to 1990. Four types of monitoring are being carried out: sources of pollution, conditions in coastal waters and estuaries, reference areas, and atmospheric transport of pollutants. Some of the research activities in the program are as follows: (1) development of sampling and analytical techniques; (2) development of reporting formats; (3) epidemiological studies related to the proposed water quality criteria for bathing waters, shellfish-growing areas, and edible marine organisms; (4) clarification of oceanographic processes, with emphasis on surface circulation and vertical transport; (5) effects of thermal discharges; (6) study of pollutant transfer processes at interfaces, by sedimentation, and through straits linking the Mediterranean with other seas. Of particular concern is mercury pollution because of the widespread mercury deposits in this region. The reported mercury concentrations in fish and other seafood are not considered sufficient to make definite conclusions, but guidelines for fish consumption are given: swordfish, bonito, bluefin tuna, and Norway lobster with the highest Hg levels (no more than one meal per week); striped mullet (1.5 meal per week) and goldband goatfish (2 meals per week); mackerel, albacore tuna, and shrimp (3 meals per week). (Cassar-PTT)
W89-00582

DETERMINATION OF TOTAL ORGANIC CHLORINE AND BROMINE IN WATER SAMPLES BY ADSORPTION ONTO ACTIVATED CARBON AND NEUTRON ACTIVATION ANALYSIS,
Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Reaktorilaboratorio.

E. Hasanen, and P. Manninen.
Chemosphere CMSHAF, Vol. 16, No. 5, p 969-972, 1987. 1 fig, 2 tab, 3 ref.

Descriptors: *Pollutant identification, *Water analysis, *Activated carbon, *Chlorine compounds, *Bromine compounds, Organic compounds, Neutron activation analysis, Adsorption, Hydrogen ion concentration, Nitrates.

A method was developed for the analysis of total organic chlorine and bromine compounds (TOCl and TOBr) in water samples. The method is based on the adsorption of organic compounds on specifically prepared activated carbon. Neutron activation analysis (neutron flux 4 times 10 to the twelfth power n per sq cm per sec) was used for the quantitative determination of chlorine and bromine. The factors investigated were the adsorption of organic chlorine and bromine compounds on activated carbon, the effect of pH on the adsorption, the removal of chlorine ions from activated carbon by nitrate washing, the amount of activated carbon required, the adsorption time, the potential number of successive adsorptions, and the preservation of samples. The detection limits for TOCl and TOBr were 5 and 0.5 microgram/liter, respectively, when the sample size was 100 ml. (Author's abstract)
W89-00588

DETERMINATION OF POLYCHLORINATED DIBENZOFURANS IN SURFACE WATER BY MEANS OF LIQUID CHROMATOGRAPHY USING ON-LINE SAMPLE PRECONCENTRATION AND DIFFERENT SPECTROSCOPIC DETECTION TECHNIQUES,
Vrije Univ., Amsterdam (Netherlands). Dept. of Analytical Chemistry.
E. B. Gonzalez, R. A. Baumann, C. Gooijer, N. H. Velthorst, and R. W. Frei.
Chemosphere CMSHAF, Vol. 16, No. 6, p 1123-1135, 1987. 6 fig, 3 tab, 11 ref.

Descriptors: *Pollutant identification, *Water analysis, *Chlorinated hydrocarbons, *Polychlorinated dibenzofurans, Chromatography, Liquid chromatography, Sample preparation, Spectroscopy, Performance evaluation.

Three different spectroscopic techniques--ultraviolet absorbance, fluorescence, and sensitized room temperature phosphorescence--were examined for the detection of polychlorinated dibenzofurans. A precolumn enrichment step was used prior to reversed-phase liquid chromographic separation. The fluorescence detection mode offered the best sensitivity and selectivity, but ultraviolet detection in combination with precolumn technology provided a powerful means for trace analysis of the dibenzofurans. The method allowed the determination of ppt-ppb concentration levels in polluted surface waters with good recoveries and reproducibility. (Author's abstract)
W89-00590

ANALYSIS OF ATRAZINE IN UNDERGROUND WATERS AT PART PER TRILLION LEVELS AS AN EARLY WARNING METHOD FOR CONTAMINATION AND FOR SOIL DISTRIBUTION STUDIES,
Istituto di Ricerche Farmacologiche Mario Negri, Milan (Italy). Lab. of Environmental Pharmacology and Toxicology.
E. Davoli, E. Benfenati, R. Bagnati, and R. Fanelli.
Chemosphere CMSHAF, Vol. 16, No. 7, p 1425-1430, 1987. 3 fig, 2 tab, 7 ref.

Descriptors: *Pesticides, *Herbicides, *Atrazine, *Chromatography, *Groundwater pollution, *Pollutant identification, Water analysis, Path of pollutants, Groundwater, Soil contamination, Italy.

A rapid, high-sensitivity method was developed for the analysis of atrazine in underground waters. It was based on the use of high resolution gas chromatography electron impact mass spectrometry and on deuterium-labeled atrazine as an internal standard. The method measures atrazine in water down to 1 ppt. Application to well waters in northern Italy showed permeation of atrazine down to 185 meters in one case: 330 ppt at 130 m, 65.3 ppt at 161 m, and 7.9 ppt at 185 m. In another well the atrazine concentration was 480 ppt at the 70-m depth and undetectable at 114 m. (Cassar-PTT)
W89-00596

ROUTINE DETERMINATION OF POLYCHLORINATED BIPHENYL RESIDUES IN FISH AND SHELLFISH IN TAIPEI COUNTY,
Food and Drug Bureau, Taipei (Taiwan).
S. S. Chou, K. C. Ho, and H. H. Chan.
Chemosphere CMSHAF, Vol. 16, Nos. 8/9, p 1835-1840, 1987. 22 ref.

Descriptors: *Pollutant identification, *Chlorinated hydrocarbons, *Fish, *Shellfish, *Polychlorinated biphenyls, Taipei, China, Organic compounds, Aromatic compounds, Chromatography, Taiwan.

A method for routine determination of polychlorinated biphenyl (PCB) residues in fish and shellfish involves saponification of the fish samples, extraction with hexane, silica gel column and gas chromatography with electron capture detection. PCBs were present in ppb concentrations in most samples of fish and shellfish from the rivers and coast of Taipei County. The mean value was 18.1 ppb; in industrial areas, 47 ppb; in rural areas, 6.9 ppb; in coastal areas, 10.1 ppb; in inland polluted rivers, 32.3 ppb. Pollutant levels were lower in shellfish than in fish, 3.2 ppb and 25.9 ppb, respectively. (Cassar-PTT)
W89-00605

EVALUATION OF DISPOSABLE MEMBRANE FILTER UNITS FOR SORPTIVE LOSSES AND SAMPLE CONTAMINATION,
Cold Regions Research and Engineering Lab., Hanover, NH.
M. E. Walsh, L. K. Knapp, and T. F. Jenkins.
Environmental Technology Letters ETLEDB, Vol. 9, No. 1, p 45-52, January 1988. 2 fig, 4 tab, 13 ref.

Descriptors: *Filtration, *Filters, *Membrane filters, *Contamination, *Sorption, *Chromatography, *Sample preparation, Performance evaluation, Chemical analysis, Solvents, Organic solvents.

Nine disposable 0.4- to 0.5-micron filter units used for routine filtration prior to high-performance liquid chromatography were tested for sample contamination from aqueous matrices. For some types of filters, contamination and sorptive losses were significant. Filtration of blanks indicated that contaminants present in the first 10 ml of filtrate can interfere with analysis. When the second 10 ml is used, contamination is eliminated. Degree of sorptive loss was a function of volume filtered and filtration rate. Analyte sorption was found to be reversible and could be mitigated by the addition of methanol as an organic modifier prior to filtration. Discarding the first 10 ml of filtrate and retaining the second 10-ml portion for analysis should assure elimination of contaminant interference and reduce sorption losses. It is suggested that specific filter units be tested with the analytes of interest prior to filtration of real samples. (Doria-PTT)
W89-00623

SEQUENTIAL EXTRACTION OF PHOSPHORUS AND HEAVY METALS FROM SEDIMENTS: METHODOLOGICAL CONSIDERATIONS,
Consiglio Nazionale delle Ricerche, Bologna (Italy). Ist. per la Geologia Marina.
A. Barbanti, and G. P. Sighinolfi.
Environmental Technology Letters ETLEDB, Vol. 9, No. 2, p 127-134, February 1988. 2 fig, 2 tab, 35 ref.

Descriptors: *Sample preparation, *Sediments, *Phosphorus, *Heavy metals, *Pollutant identification, *Chemical analysis, Iron, Manganese, Zinc, Copper, Lead, Bottom sediments, Suspended sediments, Performance evaluations, Leaching.

Two different sequential extraction procedures using hydroxylamine hydrochloride or ammonium oxalate were tested for the analysis of phosphorus, iron, and heavy metals (manganese, zinc, copper, and lead) in fine suspended and bottom sediments and in two sediment reference samples. Both procedures gave satisfactory results in terms of analytical reproducibility. However, element partitioning between some phases (reducible and oxidizable) is dependent on the extractant used. The hydroxylamine hydrochloride sequence gave results that fit better with previous experimental data. The ammonium oxalate procedure should be preferred for phosphorus. A comparison with other 'selective' techniques was performed; the use of 8N nitric acid furnishes extremely variable extraction percentages of the total, and is not a reliable indicator of the anthropogenic input of metals to the environment. (Author's abstract)
W89-00629

EFFECTS OF AQUATIC HUMIC SUBSTANCES ON ANALYSIS FOR HYDROGEN PEROXIDE USING PEROXIDASE-CATALYZED OXIDATIONS OF TRIARYLMETHANES OR P-HYDROXYPHENYLACETIC ACID,
Environmental Research Lab., Athens, GA.
For primary bibliographic entry see Field 7B.
W89-00634

FIELD MEASUREMENTS OF WATER-AIR EXCHANGE OF MERCURY IN FRESHWATER SYSTEMS,
Atmospheric Environment Service, Downsview (Ontario).
W. H. Schroeder, and F. H. Fanaki.
Environmental Technology Letters ETLEDB, Vol. 9, No. 5, p 369-374, May 1988. 3 fig, 1 tab, 19 ref.

Descriptors: *Path of pollutants, *Mercury, *Wabigoon River, *Volatiltiy, *Ontario, *Sampling, *Air pollution, Measuring instruments, Interfaces, Air-water interfaces, Heavy metals.

This study was conducted to determine if mercury is being released to the atmosphere from an inland waterway (the Wabigoon River system of N.W. Ontario, Canada) known to be contaminated with this metal from industrial wastewater discharges. Chemical and meteorological data were collected at three sites over a 3-week period during the summer of 1986. At each site, simultaneous measurements were performed of total vapor-phase Hg over water and over an adjacent land surface. A sparger device was used to probe for the presence of volatile forms of mercury dissolved in the water. Innovative sampling and analytical techniques are described and new environmental data are presented. It is concluded that the instrumentation and experimental techniques described constitute an effective approach to investigating the evolution of mercury (and, with relatively minor modifications, other volatile substances) from water into air. Studies of this type should be performed at locations removed (or upwind) from other potential mercury sources, since these can mask the water-air exchange phenomena being investigated. (Author's abstract)
W89-00640

SEDIMENT-WATER CORE SAMPLER FOR COASTAL POLLUTION STUDIES,
Consiglio Nazionale delle Ricerche, Bologna (Italy). Ist. per la Geologia Marina.
G. Busatti, A. Magagnoli, M. Mengoli, and S. Guerzoni.
Environmental Technology Letters ETLEDB, Vol. 9, No. 5, p 375-378, May 1988. 6 fig, 8 ref.

Descriptors: *Sampling, *Cores, *Sediments, *Water analysis, *Coastal waters, *Sediment-water interfaces, Interfaces, Water pollution, Adriatic Sea, Tyrrhenian Sea.

An instrument is described for recovering a core sample of sediment and water while conserving the interface between them relatively undisturbed. The instrument was used more than three years on

different environments in the North Adriatic and Tyrrhenian Seas. It proved satisfactory under all conditions, even with sandy sediments, and at different depths. Sediment cores 5-40 cm, with 150-1,050 ml of overlying water, may be obtained with little disturbance. The sampler can be employed by hand or with a small winch for ease of operation. (Author's abstract)
W89-00641

VIABILITY DETERMINATION OF ASCARIS EGGS RECOVERED FROM WASTE-WATER,
Nancy-1 Univ. (France). Faculte de Pharmacie.
J. L. Stien, and J. Schwartzbrod.
Environmental Technology Letters ETLEDB, Vol. 9, No. 5, p 401-406, May 1988. 5 tab, 21 ref.

Descriptors: *Wastewater composition, *Nematodes, *Water reuse, *Parasites, *Public health, Sampling, Eggs, Viability.

A method was investigated for detecting low levels of viable Ascaris eggs in wastewater. Water samples were artificially contaminated with suspensions of A. suum eggs. Viability was determined after n-butanol treatment, which precipitates fertile eggs. Results show that 86% of the fertile eggs separated by n-butanol were viable and 90% of the nonfertile ones were nonviable. The detection of low levels of eggs requires a minimal sample volume; 25 l was found to be the best sample size for this method. A sampling strategy was defined on the basis of time, sample type, and place of sampling. The effect of egg load on the efficiency of the method was slight. Recoveries obtained with this method compare quantitatively with those reported in the literature. The current method has the advantage of supplying information on the viability of the parasite eggs actually recovered from the water samples. Traditional methods use toxic reagents that preclude any possibility of estimating viability. (Author's abstract)
W89-00644

RELATIONSHIP BETWEEN NUMBERS OF ENTEROVIRUSES AND BACTERIOPHAGES INFECTING BACTEROIDES FRAGILIS IN DIFFERENT ENVIRONMENTAL SAMPLES,
Barcelona Univ. (Spain). Dept. of Microbiology.
C. Tartera, J. Jofre, and F. Lucena.
Environmental Technology Letters ETLEDB, Vol. 9, No. 5, p 407-410, May 1988. 3 tab, 14 ref.

Descriptors: *Viruses, *Enteroviruses, *Bacteriophage, *Bacteria, *Bioindicators, Sewage bacteria, Public health, Sediments, Microbiological studies, Sampling, Indicators, Water pollution, Spain, Human diseases.

The relationship between the amounts of enteroviruses and phages infecting Bacteroides fragilis was studied to investigate the possibility of using phages as indicators of human viruses in the environment. Samples of waters polluted by domestic sewage were collected in Barcelona; additional samples were taken in the Llobregat River before it entered Barcelona and from a wildlife refuge. Phages infecting B. fragilis were detected in 72% of the 160 polluted samples, while enteroviruses were detected in only 56% of these samples. Enteroviruses and B. fragilis phages were not detected in samples free of known human fecal pollution. Multiple correlation analysis shows no correlation between enteroviruses and phages, and no correlation between either of the two and various bacterial indicators. It is concluded that the phages infecting B. fragilis appear to indicate domestic sewage pollution. It is predicted that, once the methods for phage detection have been improved, phage will always be detected in samples containing enteroviruses. It is further concluded that the lack of correlation between the numbers of phages and enteroviruses in environmental samples does not hamper the potential use of B. fragilis phages as surrogate indicators of human viruses in these samples, since no correlation is usually found between bacterial pathogens and bacterial indicators either. (Doria-PTT)
W89-00645

DETERMINATION OF FLUORIDE ION IN WELL WATERS OF EASTWOOD SCHOOL DISTRICT, WOOD COUNTY, OHIO,
Eastwood Local Schools, Pemberville, OH.
R. M. Jones, and G. A. Parker.
Ohio Journal of Science OJSCA9, Vol. 85, No. 5, p 263-266, December 1985. 1 fig, 2 tab, 8 ref.

Descriptors: *Drinking water, *Fluorides, *Well water, *Water analysis, Hydrogen ion concentration, Ohio, Chemical analysis.

To determine the amount of fluoride ion present, the well water of Eastwood Local School District, Wood County, Ohio was analyzed. Ninety-two water samples from separate wells in the district were gathered and analyzed for fluoride content and pH level. Fluoride determination was made with a fluoride ion-selective electrode using a direct potentiometric method. Fluoride levels ranged from 0.6 to 3.8 part per million while pH measurements varied from 6.91 to 8.30. The wells seem to contain a relatively high level of fluoride ion caused perhaps by the underlying limestone aquifer. In addition to dental fluorosis, toxic fluoride levels have also been associated with skeletal fluorosis, mongolism and general ill health raising concern over the practice of adding fluoride to water supplies already containing natural fluorides. Except for the dental fluorosis, none of these have been attributed to the fluoride content of well water in the Eastwood School District and there is no evidence linking any of these illnesses to fluoride ion in this area. (Miller-PTT)
W89-00684

POLYETHYLENE GLYCOL PRECIPITATION FOR RECOVERY OF PATHOGENIC VIRUSES, INCLUDING HEPATITIS A VIRUS AND HUMAN ROTAVIRUS, FROM OYSTER, WATER, AND SEDIMENT SAMPLES,
Baylor Coll. of Medicine, Houston, TX. Dept. of Virology and Epidemiology.
G. D. Lewis, and T. G. Metcalf.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 8, p 1983-1988, August 1988. 3 fig, 6 tab, 37 ref. DOE Award DE-FG04-87AL45784 (University of Lowell, Lowell, MA, Subcontract).

Descriptors: *Pollutant identification, *Viruses, *Hepatitis-A virus, *Polyethylene glycol, *Oysters, *Sediments, Human diseases, Estuaries, Pathogens, Human rotavirus, Natural waters, Simian rotavirus, Polio virus, Rotaviruses, Chemical precipitation, Flocculation.

Polyethylene-glycol-6000 precipitation was an effective concentration method that enhanced the chances for detecting human virus pathogens in environmental samples. Recoveries from eluates of fresh and estuarine waters with 8% polyethylene glycol 6000 averaged 86% for hepatitis-A virus, 77% for human rotavirus Wa, 87% for simian rotavirus SA11, and 68% for poliovirus. Recoveries of 97, 40, 97, and 105% for the same viruses were obtained from oyster eluates by the same procedure. Recoveries of 97% for hepatitis-A virus and 78% for human rotavirus Wa were obtained from sediment eluates containing 2 M NaNO3 with a final concentration of 15% polyethylene glycol 6000. The polyethylene-glycol method was shown to be more effective than the organic-flocculation method for recovery of hepatitis-A virus and rotaviruses Wa and SA11, but not of poliovirus 1 in laboratory studies. In field trials, hepatitis-A virus or rotavirus or both were recovered from 12 of 18 eluates by polyethylene glycol, compared with recovery from 9 of 18 eluates by organic flocculation from fresh and estuarine waters subject to pollution. (Author's abstract)
W89-00730

COMPARISON OF BACTERIAL INDICATORS AND SAMPLING PROGRAMS FOR DRINKING WATER SYSTEMS,
Nancy-1 Univ. (France). Service d'Hydrologie et de Climatologie Therapeutiques.
J. F. Collin, D. Zmirou, J. P. Ferley, and M. Charrel.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 8, p 2073-2077, August 1988. 5 tab, 23 ref.

Descriptors: *Pollutant identification, *Water quality control, *Drinking water, *Bacterial analysis, *Bioindicators, *Water distribution, Comparison studies, France, Epidemiology, Rural areas, Water analysis, Coliforms, Streptococcus, Water quality standards, Water sampling, Prediction, Impaired water quality.

A total of 48 French villages was selected for a survey of water quality from February 1983 to June 1984 as part of an epidemiological study conducted in the rural area of the Rhone-Alpes region. Water samples were collected and analyzed on a weekly basis in each village. Bacteriological analysis of each water sample included enumeration of standard-plate-count bacteria, total and thermotolerant coliforms, and fecal streptococci. The water-quality regulations were examined as to the analysis frequency, the volume of samples, and the relationship between the various bacterial indicators. Analyzing 300-ml, instead of 100-ml, samples tends to generate better information on single water samples. However, if many samples are analyzed over time from the same community, the value of using large-volume water samples is diminished. The comparisons between bacterial indicators showed that the information obtained from the various indicator organisms was very similar. The predictive value for a positive test indicates the proportion of samples which test positive but are really substandard, and the predictive value for a negative test indicates the proportion of negatively-testing samples that would actually comply with the standards. With respect to the French standards, fecal streptococci had a better predictive value for negative tests than coliforms, indicating that only a small percentage of substandard determinations were false positives. (Author's abstract)
W89-00733

RAPID DETECTION OF TOTAL AND FECAL COLIFORMS IN WATER BY ENZYMATIC HYDROLYSIS OF 4-METHYLUMBELLIFERONE-BETA-D-GALACTOSIDE,
Aquateam-Norwegian Water Technology Centre of Oslo (Norway).
J. D. Berg, and L. Fiksdal.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 8, p 2118-2122, August 1988. 7 fig, 16 ref.

Descriptors: *Pollutant identification, *Bacteria, *Coliforms, *Drinking water, *Enzymes, Hydrolysis, Methylumbelliferone substrates, Fluorometry, Potable water, Raw wastewater, Detection limits, Detection times.

Three fluorogenic methylumbelliferone (MU) substrates were evaluated for rapid detection of total and fecal coliform bacteria (TC and FC) in drinking water. 4-MU-beta-D-galactoside, MU-heptanoate, and MU-glucuronide were used to determine enzyme activity as a surrogate measure of coliform concentration. Coliforms occurring in river water and in potable water artificially contaminated with raw sewage were tested. The initial rate of hydrolysis of MU-beta-D-galactoside showed promise as an indicator of TC and FC within 15 minutes. The initial rate of hydrolysis of MU-glucuronide was insufficient in the 15-minute assay, and combinations of the MU substrates did not enhance it; MU-heptanoate was not tested alone. A direct membrane-filter method incorporating MU-beta-D-galactoside into an agar medium allowed the detection of as few as 1 FC per 100 ml within 6 hours. (Author's abstract)
W89-00734

PHOSPHORUS DETERMINATION IN RIVERS (PHOSPHOR IN FLIESSGEWAESSERN UND SEINE ANALYTISCHE BESTIMMUNG),
Karlsruhe Univ. (Germany, F.R.). Engler-Bunte Inst.
F. H. Frimmel, R. Grenz, and E. Kordik.
Fresenius' Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 331, No. 3/4, p 253-259, July 1988. 7 fig, 4 tab, 16 ref. Bundesministeriums fuer

Forschung und Technologie Kennzeichen 02 WT 441/1. English summary.

Descriptors: *Chemical analysis, *Nutrients, *Phosphorus, *Water analysis, *Phosphorus compounds, *Phosphates, Germany, Dissolved solids, Photometry, Chromatography, Rivers, Spectrophotometry, Sample preparation, Organophosphorus compounds, Organic compounds, Rhine River, Danube River, Seasonal variation.

The aims of this study were to obtain information on the applicability of different analytical methods for the determination of phosphorus and P species and to provide an overview of the concentration ranges of P in some of the major rivers of the Federal Republic of Germany. About 170 river samples were analyzed for dissolved (<0.45 microns) species. The methods applied were (1) photometric determination of o-HPO4(--) as molybdophosphate, (2) determination of o-HPO4(--) by means of ion chromatography, and (3) P determination by inductively-coupled plasma spectrometry. Samples were digested before analysis. All methods yielded data of acceptable precision and turned out to be well-suited for the concentration ranges present in rivers. Dissolved total P was between 0.1 and 1 mg/l in all cases. About 50 to 70% of the dissolved total P was present as o-HPO4(--). The fraction bound to humic matter was mostly less than 1% of dissolved total P. In the Rhine the concentration of dissolved total P and o-HPO4(--) increased in the downstream direction; the reverse seemed to be true in the Danube. The Ruhr, Main, and Neckar, and especially the Emscher, which are all tributary to the Rhine, showed significantly higher concentrations. There seemed to be a concentration minimum during the summer months in the Rhine. Further application of speciation methods in combination with hydrologic data could provide a more-detailed understanding of P balances and of the fate of P compounds in river systems. (Author's abstract)
W89-00735

EVALUATION OF THE SULFUR(IV) CATALYZED AUTOXIDATION OF COBALT(II) IN AN AZIDE CONTAINING MEDIUM AS A MEANS FOR THE DETERMINATION OF SULFITE IN PRECIPITATION,
Dortmund Univ. (Germany, F.R.). Fachbereich Chemie.
J. Gebert, E. A. Neves, and D. Klockow.
Fresenius' Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 331, No. 3/4, p 260-267, July 1988. 9 fig, 45 ref.

Descriptors: *Pollutant identification, *Chemistry of precipitation, *Water pollution sources, *Acid rain, *Sulfites, *Sulfur, Cobalt, Catalysts, Azides, Fog, Clouds, Metal complexes, Dissolved oxygen, Spectrophotometry, Manganese.

Considerable attention has lately been given to the oxidation of sulfite in fog, clouds, and rainwater, because this process leads directly to the occurrence of acidic precipitation. The strong absorptivity at 365 nm of the cobalt(3+)/azide complex formed by the sulfur(4+)-catalyzed oxidation of cobalt(++) by dissolved oxygen in an azide-containing medium allows the establishment of a simple and fast spectrophotometric method for sulfite determinations in aqueous solution. With manganese(++) as an activator and 5-cm cuvettes for absorption measurements, the working range is between 5 x 10 to the minus 7 and 0.00005 mol/l sulfite. The new method was successfully applied to the investigation of rainwater samples. Of the potential interferences, only those originating from iron(3+) and formaldehyde are of practical relevance; iron interference can be avoided by proper blank correction, that from formaldehyde by a slight modification of the procedure. (Author's abstract)
W89-00736

NEGATIVE THERMAL IONIZATION MASS SPECTROMETRY OF SELENIUM: PART 1. ISOTOPE RATIO MEASUREMENTS AND DETERMINATIONS IN AQUATIC SYSTEMS WITH THE ISOTOPE DILUTION TECHNIQUE (NEGATIVE THERMIONEN-MASSEN-SPEKTROMETRIE VON SELEN: TEIL 1. ISOTOPENVERHAELTNISMESSUNGEN SOWIE KONZENTRATIONSBESTIMMUNGEN IN AQUATISCHEN SYSTEMEN MIT DER ISOTOPENVERDUENNUNGSANALYSE),
Regensburg Univ. (Germany, F.R.). Inst. fuer Anorganische Chemie.
R. Grosser, and K. G. Heumann.
Fresenius' Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 331, No. 3/4, p 268-272, July 1988. 2 fig, 3 tab, 38 ref. English summary.

Descriptors: *Pollutant identification, *Water analysis, *Selenium, *Mass spectrometry, *Isotope-dilution technique, Measuring instruments, Ionization, Reagents, Temperature effects, Standard deviation, Reproducibility, Calibrations, Trace levels, Detection limits, Isotope studies, Atomic absorption spectrophotometery.

A method of isotope-dilution mass spectrometry was used to determine selenium-isotope ratios in a double-filament ion source. A thin film of barium hydroxide was applied to the rhenium-ionization filament to increase the Se(-) thermal-ion current. The Se(-)-ion beam produced was higher by a factor of about four when selenious acid instead of barium selenite or sodium selenate was used. The ion current was strongly dependent on the temperature of the ionization filament; the maximum ion intensity occurred at 970 to 1000 C. Selenium-isotope ratios of samples with natural isotopic abundances could be determined with standard deviations of 0.3 to 0.6%. This reproducibility could lead to future improvement in the accuracy of calibrated measurement of selenium atomic weights. An enriched Se-82 spike was used with isotope-dilution mass spectrometry to analyze selenium traces in aquatic systems down to the pg/g level. Selenium content was determined in the concentration range of 4 to 23 ng/g, with standard deviations of 0.1 to 5%. The results agreed well with those obtained with a hydride-generation atomic-absorption system. The isotope-dilution mass spectrometry method analyzes the sum of the inorganic species selenate, selenite, and selenide, but not volatile organic selenium compounds. (Author's abstract)
W89-00737

DETERMINATION OF SUBSTITUTED AROMATIC AMINES IN WATER AND SEDIMENT SAMPLES,
Institut Fresenius Chemische und Biologische Laboratorien G.m.b.H., Taunusstein-Neuhof (Germany, F.R.).
B. Scholz, and N. Palauschek.
Fresenius' Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 331, No. 3/4, p 282-289, July 1988. 8 fig, 6 tab, 17 ref.

Descriptors: *Pollutant identification, *Aromatic compounds, *Water analysis, *Chemical analysis, Sediments, Anilines, Benzidines, Toxicity, Chemical wastes, Sample preparation, Quality control.

A method for the determination of at least thirty-one substituted aromatic amines (anilines and benzidines) at lower microgram/l or microgram/kg (ppb) ranges in water or sediment samples is described. Certain of these compounds are known to possess high toxicological potential. They are classical environmental pollutants by virtue of their high degree of water solubility and the large amounts produced annually in the chemical industry for the synthesis of dyes, pesticides, and pharmaceuticals. Capillary-column gas chromatography, with alkali-flame-ionization (NFI) or mass-spectrometric (MS) detection, was employed in their identification and quantification. Sample-cleanup procedures are described for aqueous and sedimentary matrices. In addition, quality-assurance aspects of identification of individual compounds by NFI or MS detection are discussed. (Author's abstract)
W89-00738

DETERMINATION OF ORGANOTINS IN NATURAL WATERS BY TOLUENE EXTRACTION AND GRAPHITE FURNACE AAS,
Water Research Centre, Medmenham (England).
S. C. Apte, and M. J. Gardner.
Talanta TLNTA2, Vol. 35, No. 7, p 539-544, July 1988. 3 fig, 2 tab, 23 ref.

Descriptors: *Pollutant identification, *Tin, *Organo-tins, *Atomic absorption spectrometry, *Chemical analysis, *Water analysis, Toluene extraction, Natural waters, Graphite-furnace atomic absorption spectrometry, Biocides, Antifouling preparations, Hydrogen ion concentration, Tributyl tin, Detection limits, Standard deviation, Seawater.

Tributyl tin is the active biocidal constituent of many antifouling preparations currently used to coat the hulls of boats; much concern has been expressed over the potentially harmful effects of tributyl tin on many forms of marine life, even when this substance is present at low ng/l concentrations. The determination of tributyl tin in natural waters by extraction into toluene and graphite-furnace atomic-absorption spectrometry (AAS) measurement of tin was investigated. The effect of pH on the extraction of mono-, di-, and tributyl tin and triphenyl tin was examined and the optimum conditions for the estimation of tributyl tin assessed. The AAS performance was greatly improved by using furnace tubes pretreated by soaking in sodium tungstate solution. Such pretreatment was essential if low detection limits were to be attained. Extraction of the tributyl tin from aqueous media resulted in a marked signal enhancement (irrespective of the type of furnace tube), which varied according to the nature of the aqueous solution. The enhancement is the result of water in the toluene extract activating the tube surface. Methods for the estimation of tributyl tin in waters, appropriate for screening samples as part of routine monitoring programs, are described. With a 1-liter sample, a limit of detection of approximately 4 ng/l was attained for tin. The relative standard deviation of six replicate analyses of seawater containing 170 ng/l tin (present as tributyl tin) was 1.5%. (Shidler-PTT)
W89-00743

SEDIMENT ANALYSIS: LABILITY OF SELECTIVELY EXTRACTED FRACTIONS,
Newcastle Univ. (Australia). Dept. of Chemistry.
T. U. Aualiitia, and W. F. Pickering.
Talanta TLNTA2, Vol. 35, No. 7, p 559-566, July 1988. 7 fig, 2 tab, 14 ref.

Descriptors: *Pollutant identification, *Sediments, *Heavy metals, *Atomic absorption spectroscopy, *Anodic stripping voltammetry, Lability, Chemical analysis, Industrial wastes, Marine sediments.

Contaminated samples (two process wastes and seven estuarine sediments) were extracted with a series of chemical solutions widely used in soil and sediment analyses. The Cu, Pb, and Cd contents of the extracts were then determined by both atomic absorption spectroscopy and anodic stripping voltammetry (ASV), and it was found that not all of the metal ion retrieved was 'labile'. Differences between selected extraction values were compared with the bonding-mode category values obtained by using a well-known sequential extraction procedure, and it was found that the series and sequential approaches yielded different results for Pb and Cu. The advantages and limitations of ASV monitoring in sediment studies are considered and the inappropriateness of some operationally-defined fraction categories is indicated. (Author's abstract)
W89-00744

COMPARISON OF INSTREAM AND LABORATORY METHODS OF MEASURING SEDIMENT OXYGEN DEMAND,
Geological Survey, Rolla, MO. Water Resources Div.
For primary bibliographic entry see Field 7B.
W89-00869

EPIDEMIOLOGICAL STUDY OF THE LEGIONELLA PNEUMOPHILA PRESENCE IN POTABLE WATER IN ALICANTE,

Municipal Waters of Alicante (Spain).
A. M. Campo, and D. Apraiz.
Aqua AQUAAA, No. 3, p 116-119, 1988. 5 tab, 30 ref.

Descriptors: *Potable water, *Epidemiology, *Spain, *Drinking water, *Bacteria, *Legionnaires disease, Storage tanks, Pontiac fever, Alicante, Human disease, Water conveyance.

An epidemiological study was carried out to determine the presence of Legionella pneumophila in waters of different origin: (1) cold water without disinfection treatment, (2) treated cold water, and (3) treated hot water. There was only one bacterium isolation in the hot water samples with a very high percentage (49.2%) finding ten strains of serogroup 1, three of serogroup 8 and two of serogroup 6. The influence of physiochemical parameters (chlorine, temperature and conductivity) is discussed as well as the role of the storage tanks in the growth of Legionella pneumophila. (Author's abstract)
W89-00925

ACTIVITY ASSESSMENT IN DRINKING WATER BACTERIOLOGY - A COMPARISON OF METHODS AND POSSIBILITIES,
Kongelige Veterinaer- og Landbohoejskole, Copenhagen (Denmark). Inst. of Veterinary Microbiology and Hygiene.
E. Korsholm, and H. Sogaard.
Aqua AQUAAA, No. 3, p 133-136, 1988. 2 fig, 4 tab, 21 ref.

Descriptors: *Drinking water, *Bacteria, *Microbiological studies, *Pollutant identification, Denmark, Acridine orange, Cell activity, Comparison studies.

Two methods, in which acridine-orange direct counts are combined with demonstration of cell-metabolic activity, were evaluated on 24 drinking water samples. Two methods were used: (1) the INT method based on tetrazolium reduction, and (2) the NA-method based on nalidixic acid inhibition. Active counts obtained from these two methods were compared with the determination of the red-orange fluorescing proportion of acridine-orange direct counts made prior to incubation, and with plate counts using two different media (R2A and Kings agar B). The percentage of INT-active cells showed a significant positive correlation ($r = 0.56$) with the percentage of red-orange fluorescing cells. This was not seen with the NA-method, which in all samples showed the lower active count of the two. On the basis of the acridine-orange binding theory, a growth cycle experiment, and the observed correlation, it is proposed that red-orange fluorescence reveals activity at a lower level than the INT/NA methods. (Author's abstract)
W89-00928

DETERMINATION OF PHOSPHATE AT LOW CONCENTRATIONS IN SURFACE WATERS BY FLOW-INJECTION ANALYSIS,
Hydrological Research Inst., Pretoria (South Africa).
J. J. Pauer, H. R. van Vliet, and J. F. van Staden.
Water SA, Vol. 14, No. 3, p 125-130, July 1988. 5 fig, 4 tab, 13 ref.

Descriptors: *Phosphates, *Water analysis, *Pollutant identification, *Colorimetry, Surface waters, Molybdenum blue.

A flow-injection method for the determination of phosphate in surface waters was developed. The molybdenum blue colorimetric method, with tin(II) chloride as a reducing agent, was used. The calibration curve was linear up to 500 micrograms/liter while a good precision and accuracy were achieved. Using an Auto Analyzer colorimeter with a debubble type flow cell, a sample frequency of 90 samples/hr was obtained. To compensate for the interfering effect of Mercury(II) on the sensitivity of the molybdenum blue reaction, both samples and standard solutions were preserved with the same amount of mercury(II) chloride. (Author's abstract)
W89-00931

THERE'S NO SUCH THING AS A REPRESENTATIVE GROUND WATER SAMPLE,
Leggette, Brashears and Graham, Inc., St. Paul, MN.
J. D. Pennino.
Ground Water Monitoring Review GWMRDU, Vol. 8, No. 3, p 4-9, Summer 1988. 2 tab, 11 ref.

Descriptors: *Sampling, *Water analysis, *Groundwater, *Water quality, *Wells, *Water sampling, Well water, Monitoring wells, Groundwater pollution, Chemical properties.

The difficulties of obtaining a representative sample of ground water for water-quality analysis are discussed. Any approach to purging and sampling of wells must account for the changes in the groundwater and contaminant chemistry during purging and sampling. In order to evaluate the effects on the groundwater quality from well installation, well development, purging, and sampling, the source of the sample should be characterized. Sample source characterization means characterizing sources of contaminants and changes in the groundwater chemistry as a result of well installation, sampling and related activities. Sample source characterization involves: (1) determining what constitutes background groundwater quality, (2) identifying sources of contamination in the materials introduced into the groundwater during monitoring well installation, and (3) monitoring the changes in groundwater quality caused by the physical process of well installation, development, purging and sampling. (Miller-PTT)
W89-00937

RELIABILITY OF CHEMICAL ANALYSES OF WATER SAMPLES: THE EXPERIENCE OF THE UMTRA PROJECT,
Weston (Roy F.), Inc., Albuquerque, NM.
G. Rice, J. Brinkman, and D. Muller.
Ground Water Monitoring Review GWMRDU, Vol. 8, No. 3, p 71-75, Summer 1988. 4 tab, 1 fig.
DOE Contract DE-AC04-82AL14086.

Descriptors: *Water analysis, *Water quality, *Quality control, *Groundwater pollution, *Laboratories, *Uranium, Mine wastes.

Since groundwater quality investigations require reliable chemical analyses of water samples, it is unfortunate that laboratory analytical results are often unreliable. The solution of Uranium Mill Tailings Remedial Action Project was to establish a two-phase quality assurance program for the analysis of water samples. In the first phase, eight laboratories analyzed three solutions of known composition. The analytical accuracy of each laboratory was ranked and three laboratories were awarded contracts. The second phase consists of on-going monitoring of the reliability of the selected laboratories. The following conclusions are based on two years of experience with the Quality Assurance Program of the Uranium Mill Tailings Remedial Action Project: (1) the reliability of laboratory analyses should not be taken for granted, (2) analytical reliability may be independent of the prices charged by the laboratories, and (3) quality assurance programs benefit both the customer and the laboratory. (Author's abstract)
W89-00941

USE OF TOTAL ORGANIC CARBON AS AN INDICATOR OF CONTAMINATION FROM AN OIL REFINERY, SOUTH-CENTRAL KANSAS,
Kansas State Geological Survey, Lawrence.
T. B. Spruill.
Ground Water Monitoring Review GWMRDU, Vol. 8, No. 3, p 76-82, Summer 1988. 3 fig, 3 tab, 16 ref.

Descriptors: *Water analysis, *Oil wastes, *Gas chromatography, *Hydrocarbons, *Pollutant identification, *Groundwater pollution, *Oil pollution sources, *Organic carbon, Indicators, Oil refineries, Water pollution, Kansas.

Water samples collected from 26 sites at an abandoned oil refinery in south-central Kansas were analyzed for total organic carbon and specific volatile and semivolatile organic compounds by gas chromatography/mass spectrometric methods. Results from a Spearman-rho correlation analysis between total organic carbon concentration and the number of compounds (correlation coefficient = 0.71) and total organic carbon concentration and concentration of compounds identified (correlation coefficient = 0.83) indicate correlations significant at the 0.01 level. Although total organic carbon data alone would not be sufficient to evaluate hazards posed by oil-refinery wastes, results of correlation analysis performed using data collected from the site in Kansas indicate that total organic carbon data can be used effectively to delineate petroleum-related groundwater contamination and to help identify the sources of groundwater contaminants. Total organic carbon data collected from a large number of temporary sampling points during the initial phases of investigation will provide an estimate of the extent of hydrocarbon contamination and allow placement of monitoring wells and more detailed sampling in appropriate areas. (Author's abstract)
W89-00942

OXYGEN TRANSFER THROUGH FLEXIBLE TUBING AND ITS EFFECTS ON GROUND WATER SAMPLING RESULTS,
Illinois State Water Survey Div., Champaign. Aquatic Chemistry Section.
T. R. Holm, G. K. George, and M. J. Barcelona.
Ground Water Monitoring Review GWMRDU, Vol. 8, No. 3, p 83-89, Summer 1988. 6 fig, 2 tab, 20 ref.

Descriptors: *Sampling, *Chemical analysis, *Sample preservation, *Carbon dioxide, *Groundwater, *Water sampling, *Oxygen transfer, Tubes, Model studies, Dissolved oxygen.

Because groundwater are typically undersaturated with oxygen and oversaturated with carbon dioxide with respect to atmospheric partial pressures, gas transfer may occur during sampling and cause detectable changes in the groundwater chemical analysis. A model for the diffusion of gases through polymeric tubing was derived which predicts that the amount of gas transferred is proportional to the tubing length and inversely proportional to the pumping rate. The model was experimentally tested and confirmed for oxygen transfer through fluorinated ethylene-propylene copolymer tubing using tubing lengths and flow rates typical of ground water sampling. Diffusion can introduce measurable concentrations of oxygen into initially anoxic water. Diffusive loss of carbon dioxide from water that is oversaturated with respect to atmospheric CO2 does not measurably affect pH under similar usage conditions. (Miller-PTT)
W89-00943

SENSITIVITY OF FOUR MONITORING WELL SAMPLING SYSTEMS TO LOW CONCENTRATION OF THREE VOLATILE ORGANICS,
Battelle Pacific Northwest Labs., Richland, WA. Geosciences Dept.
R. Schalla, D. A. Myers, M. A. Simmons, J. M. Thomas, and A. P. Toste.
Ground Water Monitoring Review GWMRDU, Vol. 8, No. 3, p 90-96, Summer 1988. 5 fig, 1 tab, 15 ref.

Descriptors: *Monitoring, *Sampling, *Water analysis, *Water sampling, *Chlorinated hydrocarbons, Aquifers, *Groundwater pollution, *Hazardous waste disposal, Chemical analysis, Well, Well water.

Four state-of-the-art groundwater sampling systems were analyzed to determine their reliability in providing representative samples of volatile chlorinated hydrocarbons (such as trichloroethylene, perchloroethylene and 1,1,1-trichloroethane) from a simulated monitoring well. The sampling systems studied represent four commonly used devices, including: (1) a stainless steel and Teflon piston pump, (2) a Teflon bailer, (3) a Teflon bladder

pump, and (4) a polyvinyl chloride air-lift pump. Controlled laboratory sampling experiments were conducted in a tank and well test chamber designed to approximate field conditions. A well purging and sampling procedure was used in the test apparatus to determine the accuracy and precision of each device for detecting low concentrations of the compounds in groundwater. The compounds selected are some of the most ubiquitous hazardous contaminants found in shallow aquifers near hazardous waste sites throughout the United States. No significant statistical difference was found among the four sampling systems in detecting the compounds. (Author's abstract)
W89-00944

SCREENED AUGER SAMPLING: THE TECHNIQUE AND TWO CASE STUDIES,
Jordan (Edward C.) Co., Inc., Portland, ME.
T. W. Taylor, and M. C. Serafini.
Ground Water Monitoring Review GWMRDU, Vol. 8, No. 3, p 145-152, Summer 1988. 6 fig, 3 tab.

Descriptors: *Sampling, *Monitoring wells, *Water sampling, *Aquifers, *Wells, *Groundwater pollution, *Pollutant identification, Screened auger, Well water, Sand aquifers, Michigan, Chromium, Organic compounds.

Screened auger sampling has provided an efficient method for investigating hexavalent chromium and volatile organic compound contamination in two sandy aquifers in Cadillac, Michigan. The aquifers approach 200 feet in thickness and more than one square mile in area. A series of screened auger borings and monitoring wells was installed, and ground water was collected at 10-foot intervals as the boreholes were advanced to define the horizontal and vertical distribution of the contaminant plumes. The ability of the screened auger to obtain representative groundwater samples was supported by the statistical comparison of field screening results and subsequent laboratory analysis of groundwater from installed monitoring wells. (Author's abstract)
W89-00945

DISCRETE POINT SAMPLER FOR GROUND WATER MONITORING WELLS,
Oregon Graduate Center, Beaverton. Dept. of Environmental Science and Engineering.
For primary bibliographic entry see Field 7B.
W89-00947

METHOD FOR LOCATING WELLS IN A GROUNDWATER MONITORING NETWORK UNDER CONDITIONS OF UNCERTAINTY,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7A.
W89-00971

MICRONUCLEUS TEST: EXAMPLES OF APPLICATION TO MARINE ECOLOGY,
Padua Univ. (Italy). Dept. of Biology.
R. Brunetti, F. Majone, I. Gola, and C. Beltrame.
Marine Ecology Progress Series MESEDT, Vol. 44, No. 1, p 65-68, April 21, 1988. 2 fig, 2 tab, 20 ref.

Descriptors: *Tissue analysis, *Bioindicators, *Water pollution, *Mussels, *Gills, *Monitoring, Water pollution effects, Indicators, Mollusks, Mytilus, Sampling.

The possibility of using micronucleus frequencies detected in natural mussel populations as indicators of the genotoxicity of marine water pollutants was investigated using gill tissue of Mytilus galloprovincialis. Mussels were collected from stations in the Venice Lagoon and La Spezia Roads (Italy) characterized by different degrees of pollution. The test seemed to be a very sensitive indicator of the presence of genotoxic contaminants. However, the mean micronucleus frequency was very low where the mussel population was scarce. It is concluded that the use of micronucleus frequencies for the evaluation of environmental pollution may be limited to situations where sample stations lie within a range of environmental conditions that do not induce mortality. (Doria-PTT)
W89-01042

SIMPLE, RELIABLE, AND INEXPENSIVE PORE-WATER SAMPLER,
Skidaway Inst. of Oceanography, Savannah, GA.
For primary bibliographic entry see Field 7B.
W89-01051

PRECIPITATION AND INDIRECT SPECTROPHOTOMETRIC DETERMINATION OF SULFATE TRACES IN FRESH WATER WITH LEAD NITRATE AND TETRAPHENYLPORPHINE TRISULFONIC ACID,
Kanazawa Univ. (Japan). Dept. of Chemistry.
T. Honjo, and N. Hayashi.
Fresenius' Zeitschriftfuer Analytische Chemie ZACFAU, Vol. 330, No. 8, p 713-714, May 1988. 2 tab, 3 ref.

Descriptors: *Water analysis, *Sulfates, *Spectrophotometry, *Chemical analysis, Trace levels.

A new method for the indirect spectrophotometric determination of sulfate at ppm levels in fresh water has been established using lead nitrate and tetraphenylporphine trisulfonic acid. Non of the ions investigated (Al(3+), Mn(2+), Fe (3+), Cu(2+), Mg(2+), I(-), Cl(-), Br(-), Co3(2-), Mg (2+), I(-), Cl(-), Br(-), NO3(-)) interfered with the determination of sulfate traces. Sulfate could be determined a 6-10 ppm levels in freshwater (Stoehr.-PTT)
W89-01085

GAS CHROMATOGRAPHIC-MASS SPECTROMETRIC INVESTIGATIONS ON LIPOPHILIC ANTHROPOGENIC SUBSTANCES IN ENVIRONMENTAL SAMPLES. II: A SPLITTER FOR THE SIMULTANEOUS DETECTION OF CAPILLARY GAS CHROMATOGRAMS BY UP TO FOUR DIFFERENT GC-DETECTORS,
Biologische Anstalt Helgoland (Germany, F.R.)
D. Janssen.
Fresenius' Zeitschrift fuer Anaytische Chemie ZACFAU, Vol. 331, No. 1, p 20-26, June 1988. 2 fig, 2 tab, 13 ref.

Descriptors: *Pollutant identification, *Chromatography, *Mass spectrometry, *Chemical analysis, *Water analysis, *Gas chromatography, Qualitative analysis, Elbe River, Lindane, Parathion, Agricultural chemicals, Pesticides.

A device has been developed that splits the eluent of a capillary gas chromatograph, GC, into four streams, allowing the simultaneous use of up to four different detectors. The rather insensitive but unspecific flame ionization detector, FID, was combined with 1 to 3 more or less element-specific detectors. The additional information obtained by the element-specific detectors allows a directed search for certain substance peaks during a GC-MS analysis under identical conditions in a very narrow range of the total ion chromatogram of the mass spectrometer. Substance peaks that are overlapping and completely covered by much greater matrix peaks also can be investigated. Even without GC-MS analysis the GC driven by the four-fold eluent splitter gave valuable information. As the peak areas of a substance from the various detectors must be in a certain ratio to each other, simultaneous multidetection allows at least a good semiqualitative estimation of the substance amounts. The capability of the splitter is demonstrated by an investigation of a water sample from the river Elbe. Three compounds were selected for analysis (lindane, methyl parathion, and 2-(methylmercapto) benzothiazole. All three compounds were successfully identified by: (1) retention time, (2) signal ratio of each detector, and (3) mass spectrometry. (Stoehr-PTT)
W89-01086

DETERMINATION OF THIRAM IN WATER AND SOILS BY CATHODIC STRIPPING VOLTAMMETRY BASED ON ADSORPTIVE ACCUMULATION,
Universidad Autonoma de Madrid (Spain). Dept. de Quimica.
J. R. Procopio, M. T. Sevilla Escribano, and L. H. Hernandez.
Fresenius' Zeitschrift fuer Anaytische Chemie ZACFAU, Vol. 331, No. 1, p 27-29, June 1988. 2 fig, 2 tab, 13 ref. DGICyT project PA86-0367.

Descriptors: *Thiram, *Fungicides, *Soil analysis, *Water analysis, *Pesticides, Agricultural chemicals, Chemical analysis, Adsorption, Cathodes, Voltammetry, Accumulation, Calibrations.

A sensitive electrochemical stripping procedure was developed for the detection of thiram. Accumulation is achieved by adsorption of the compound on the hanging mercury drop electrode. Optimal experimental parameters include an accumulation potential of -0.2 V vs. Ag/AgCl, a 0.075 mol/liter ammonia solution as supporting electrolyte and a differential pulse stripping mode. The detection limit is 0.3 ng/ml after 120 s accumulation and 0.03 ng/ml after 600 s accumulation. The main interference, which came from metalss that form complexes with thiram, may be eliminated by addition EDTA before extraction. Becaue of its low detection limit, the method is suitable for the determination of low thiram concentrations as found in water and soil, after its application to crop soils. (Stoehr-PTT)
W89-01087

NITRILOTRIACETIC ACID (NTA) ENVIRONMENTAL MONITORING PROGRAM IN INDIANA: 1979 TO 1983,
Procter and Gamble Co., Cincinnati, OH. Environmental Safety Dept.
R. H. Wendt, A. G. Payne, and W. D. Hopping.
Environmental Toxicology and Chemistry ETOCDK, Vol. 7, No. 4, p 275-290, April 1988. 7 fig, 10 tab, 19 ref.

Descriptors: *Indiana, *Metals, *Monitoring, *Nitrilotriacetic acid, *Detergents, *Municipal wastewater, Drinking water, Surface water, Wastewater treatment, Sampling, Trickling filters, Activated sludge process, Copper, Zinc, Cadmium, Lead, Chromium, Toxicity.

The environmental concentrations of nitrilotriacetic acid (NTA) resulting from its use in laundry detergents were monitored during a four-year study conducted in central Indiana. The purpose of the study was to measure NTA concentrations in municipal wastewater, in surface waters that receive wastewater effluent and in finished drinking water from surface waters downstream from the outfalls of wastewater treatment plants. The 25 sampling sites were interdependent locations in and around Indianapolis, Indiana, an area that received laundry detergents containing Na3NTA at a level equivalent to 3.6% NTA in all detergents (w/w) during the last two years of the program. NTA removal during wastewater treatment averaged 91% at activated sludge treatment plants and 65% at trickling filter plants. NTA concentrations averaged 0.008 micrograms/ml in river waters and 0.004 micrograms/ml in drinking waters when NTA containing detergents were in use. NTA concentrations in wastewaters, river waters and drinking waters were similar to or lower than concentrations predicted from usage levels and agreed, within a factor of 3, with the predicted values. Concentrations of six metals (Cu, Ni, Cd, Pb, CR and Zn) were also measured in samples collected throughout the program. Concentrations of the metals in influent wastewater, their removal by wastewater treatment and their concentrations in river and finished drinking waters were comparable with values typical in the United States. Use of NTA in laundry detergents did not affect metals removal by wastewater treatment or metals concentrations in river and drinking waters. (Author's abstract)
W89-01089

ORGANOCHLORINE AND MERCURY RESIDUES IN WILD MINK AND OTTER: COMPARISON WITH FISH,
New York State Dept. of Environmental Conser-

vation, Gloversville. Hale Creek Field Station.
For primary bibliographic entry see Field 5B.
W89-01093

COMPARISON OF THREE SEDIMENT BIOASSAY METHODS USING DETROIT RIVER SEDIMENTS,
Michigan State Univ., East Lansing. Pesticide Research Center.
J. P. Giesy, R. L. Graney, J. L. Newsted, C. J. Rosiu, and A. Benda.
Environmental Toxicology and Chemistry ETOCDK, Vol. 7, No. 6, p 483-498, June 1988. 6 fig, 9 tab, 97 ref.

Descriptors: *Toxicity, *Bioassay, *Sediments, *Rivers, *Detroit, *Michigan, Bacteria, Insects, Daphnia magna, Chironomus tentans, Benthic fauna, Interstitial water, Statistical analysis.

The relative sensitivities and discrimination abilities of the Daphnia magna 48-h lethality assay of sediment pore water, the Photobacterium phosphoreum 15-min bioluminescence inhibition (Microtox) assay of sediment pore water and the Chironomus tentans 10-d growth reduction assay of whole Detroit River sediments were investigated and predictive relationships developed. While all three assays demonstrated the toxicity of some sediments and all of them identified the most and least toxic sediment, the D. Magna lethality assay was the least sensitive and discriminatory. The Microtox assay was the most sensitive. Based on lethality, the C. Tentans assay was less sensitive than D. Magna, but growth inhibition was sensitive and the most discriminatory of the three assays. Chironomids were not observed in the sediments that caused a 30% decrease in growth of C. Tentans relative to that on control sediment in which chironomids were observed. The results of all of the assays were correlated, but none of the assays accurately predicted the results of the other two. It was concluded that the D. Magna lethality test could be used to predict which sediments were so toxic that benthic insects would not be expected to be present. A principal components analysis demonstrated that the Microtox assay gave sufficiently different information that it could be included in a battery of sediment toxicity tests designed to accurately classify the toxicities of sediments. (Author's abstract)
W89-01097

COMPARING HEADSPACE WITH PURGE AND TRAP FOR ANALYSIS OF VOLATILE PRIORITY POLLUTANTS,
Hewlett-Packard Co., Avondale, PA. Avondale Div.
P. L. Wylie.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 8, p 65-72, August 1988. 11 fig, 3 tab, 24 ref.

Descriptors: *Pollutant identification, *Organic compounds, *Water analysis, *Sampling, *Gas chromatography, Volatile organic compounds, Headspace sampling, Purge-and-trap techniques, Comparison studies, Performance evaluation, Automation.

Headspace sampling was compared with purge-and-trap techniques for the gas chromatographic analysis of volatile pollutants in water. Using optimized headspace conditions, this technique was as sensitive as the purge-and-trap. The precision of 24 sequential headspace injections was better than that for purge-and-trap analyses. The advantages of headspace sampling are automation to 24 samples, no change of contamination from foaming or high concentrations of analyte, wide variety of matrixes which can be sampled, portability, disposability of glassware, use in field without a transfer step, connection of two headspace samplers to one chromatography thus doubling the capacity, and use of the same sampling parameters for EPA methods 601 and 602. The disadvantages of headspace sampling are the possibility of injecting ambient air and interference from water injected with aqueous samples. Advantages of purge-and-trap sampling are automation up to 10 samples and EPA endorsement. Disadvantages of purge-and-trap sampling are loss of light volatiles with excessive purge times or flow rates, danger of contamination from previous samples and foaming, interference from ambient air, expensive and fragile glassware which must be carefully washed, low sample throughput, and different configurations for EPA methods 601 and 602. (Cassar-PTT)
W89-01119

MICROCOMPUTER-BASED MEASUREMENT OF ALGAL FLUORESCENCE AS A POTENTIAL INDICATOR OF ENVIRONMENTAL CONTAMINATION,
Waterloo Univ. (Ontario). Dept. of Biology.
C. I. Mayfield, and M. Munawar.
Bulletin of Environmental Contamination and Toxicology BECTA6. Vol. 41, No. 2, p 261-266, August 1988. 1 fig, 2 tab, 4 ref.

Descriptors: *Pollutant identification, *Data acquisition, *Computers, *Fluorometry, *Algae, Toxicity, Measuring instruments, Videoimaging, Microscopy, Chlorophyll, Fluorescence, Mercury, Metals, Chlorella, Phytoplankton.

The recent availability of inexpensive interfaces between microcomputers and video cameras has made possible videoimaging-and-analysis systems which are able to measure the relative brightness of many individual points in a microscope image. One such system was designed to operate with a uv-fluorescence microscope, providing video images of the chlorophyll fluorescence of living algal cells; these images were then analyzed with the aid of a microcomputer. Two tests showed that the videoimaging-microcomputer system was able to distinguish changes in chlorophyll-fluorescence intensities due to treatment with mercury and mixtures of metals. In the first, progressively longer exposure to mercury decreased the average chlorophyll fluorescence of Chlorella vulgaris cells. The second test involved the treatment of a natural phytoplankton population from Lake Ontario with 1 and 10 times the recommended levels of metal mixtures and resulted in a significant decrease in chlorophyll fluorescence at the 10x concentration. There was no significant decrease after a 20-hour exposure at the 1x concentration. More comparative testing is required to validate this toxicity-measurement approach, but at the least it seems that responses of chlorophyll to uv light differ according to the prior treatment with metals. (Shidler-PTT)
W89-01157

IS WATER A RELEVANT SAMPLING MEDIUM FOR TOXIC CHEMICALS: AN ALTERNATIVE ENVIRONMENTAL SENSING STRATEGY,
National Water Research Inst., Burlington (Ontario).
E. D. Ongley, D. A. Birkholz, J. H. Carey, and M. R. Samoiloff.
Journal of Environmental Quality JEVQAA, Vol. 17, No. 3, p 391-401, July-September 1988. 6 fig, 5 tab, 26 ref.

Descriptors: *Pollutant identification, *Water sampling, *Bottom sampling, *Pollutants, *Environmental quality, Comparison studies, Path of pollutants, Synoptic analysis, Low flow, Sample preparation, Bioassay, Suspended sediments, Toxicity, Water quality, Cost analysis, Environmental policy.

Using an uncomplicated 960 km reach of the North Saskatchewan River, pathways and distribution of anthropogenic contaminants in water and in suspended and bottom sediments were examined. Synoptic sampling during stable low flow allowed maximum inference of point sources and, therefore, of chemical complexity. After chemical extraction of contaminants into two fractions for aqueous samples, and five fractions for sediment samples, it was possible to assess the toxicity of the fractions using two independent bioassays--the Panagrellus redivivus nematode assay and a nonstandard modification of the Ames bacterial test. There was little comparability between the toxic response of whole water samples and of suspended sediments contained in the whole water samples. There was a much greater toxic response and larger number of priority chemicals associated with suspended sediments than was found in water samples. Observed priority chemicals could exist in water or on sediments, yet produce no toxic response in one or both of the bioassay procedures. Significant toxicity was also observed in the absence of priority chemicals. These results led to questioning the efficacy of applying a standard menu of priority chemicals to water samples for ambient (i.e., not end-of-pipe) aquatic quality monitoring purposes. It is concluded that water may be an inappropriate medium upon which to base criteria for toxic chemical sensing purposes in aquatic systems and that the menu approach to toxic chemical sensing was neither cost nor information efficient. An alternative sensing protocol is proposed which uses a coupled chemical-bioassay protocol that reduces the number of chemicals analyzed, produces an objective biological index of relative toxic response, provides a backup for the presence of toxic chemicals not included in the chemical screen, and conveys meaningful ecological information upon which agencies can make program decisions. (Author's abstract)
W89-01162

REVIEW OF THE USE OF XAD RESINS TO CONCENTRATE ORGANIC COMPOUNDS IN WATER,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
S. A. Daignault, D. K. Noot, D. T. Williams, and P. M. Huck.
Water Research WATRAG, Vol. 22, No. 7, p 803-813, July 1988. 1 tab, 76 ref.

Descriptors: *Pollutant identification, *Water treatment, *Literature review, *Organic compounds, *Mutagenicity, *Resins, *XAD resins, Drinking water, Amberlite, Adsorbents, Sorption, Disinfection.

The current and historical literature pertaining to the use of Amberlite (registered trademark) XAD resins for isolating and concentrating organic compounds is reviewed. The focus is on XAD-2 and XAD-4 resins and their use in concentrating organics from drinking water for mutagenicity studies. Factors affecting solute adsorption/desorption are addressed, as are resin cleaning and regeneration methods. The identification and elimination of resin artifacts are discussed as well as the possible mutagenic potential of these artifacts or of their disinfection by-products, principally resulting from their reaction with chlorine. (Author's abstract)
W89-01215

GRAVIMETRIC MEASUREMENT OF ADSORPTION PARAMETERS IN WATER SYSTEMS WITH A QUARTZ SPRING BALANCE,
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
K. E. Noll, and V. Gounaris.
Water Research WATRAG, Vol. 22, No. 7, p 815-823, July 1988. 10 fig, 4 tab, 29 ref.

Descriptors: *Pollutant identification, *Adsorption, *Gravimetric analysis, *Water treatment, *Measuring instruments, Differential reactors, Equilibrium, Kinetics, Adsorbents, Activated carbon, Resins, Phenols, Buoyancy, Freundlich isotherm model.

A technique utilizing a differential reactor was applied to liquid/solid systems. The method allowed both equilibrium and kinetic parameters to be determined simultaneously. Tests were conducted with four adsorption systems. The adsorbents were F400 activated carbon and XAD-4 polymeric resin, while phenol (PNL) and p-chlorophenol (PCP) were used as adsorbates. The gravimetric measurements were complicated by the effect of buoyancy; however, this buoyancy factor was constant for each water/solid adsorption system, and was determined experimentally. It was possible to explain the buoyancy effect theoretically, in terms of equivolume displacement of water, for the XAD-4 systems, but not for those of carbon. The results obtained for the K isotherm of the Freund-

lich model (derived gravimetrically from experiments at constant solute concentration) were 2.31 for PNL/XAD-4, 15.2 for PCP/XAD-4, 86.7 for PNL/F400, and 138 for PCP/F400. The adsorption parameters obtained by the new method were in good agreement with those of 2.01, 12.96, 68, and 146 found in the literature for the same parameter and the same adsorption systems. The spring-balance configuration, combining the mathematical advantages of a differential reactor and the simplicity of gravimetric measurement was shown to be an effective tool for the measurement of equilibrium and kinetic parameters of adsorption, and applicable to fixed-bed adsorption. (Shidler--PTT)
W89-01216

DETECTION OF ENVIRONMENTAL VIRUSES IN SLUDGE: ENHANCEMENT OF ENTEROVIRUS PLAQUE ASSAY TITERS WITH 5-IODO-2'-DEOXYURIDINE AND COMPARISON TO ADENOVIRUS AND COLIPHAGE TITERS,
Health Effects Research Lab., Cincinnati, OH.
F. P. Williams, and C. J. Hurst.
Water Research WATRAG, Vol. 22, No. 7, p 847-851, July 1988. 2 tab, 19 ref.

Descriptors: *Pollutant identification, *Sludge, *Wastewater treatment, *Viruses, *Bacteriophage, *Bioassay, Primary sludge, Environmental viruses, 5-Iodo-2'-deoxyuridine, Comparison studies, Quantitative analysis, Incubation, Enteroviruses, Adenoviruses, Coliphages, Escherichia coli, Fluorometry.

Enteroviruses present in the primary sludge of two wastewater-treatment plants were quantitatively analyzed using a continuous African green monkey kidney-cell line (BGM). Incubation of BGM monolayers with 50 micrograms per ml 5-iodo-2'-deoxyuridine (IDU) for 4 days prior to use enhanced the number of plaque-forming units detected in 10 of 10 concentrated sludge samples. Coliphages also present in these samples were detected using as hosts Escherichia coli C and E. coli A-19, an Hfr strain. E. coli C coliphage titers were consistently higher than E. coli A-19 titers, and were 100-1000 times higher than the enterovirus titers obtained with BGM cells. Adenoviruses present in the sludge samples were detected by immunofluorescence assay. Interestingly, those results suggested that adenoviruses were also more numerous than enteroviruses (as detected by either IDU-treated or untreated BGM plaque assay). (Author's abstract)
W89-01220

EVALUATION AND COMPARISON OF TWO SHORT-TERM FATHEAD MINNOW TESTS FOR ESTIMATING CHRONIC TOXICITY,
Environmental Monitoring and Support Lab.-Cincinnati, OH. Biological Methods Branch.
Q. H. Pickering.
Water Research WATRAG, Vol. 22, No. 7, p 883-893, July 1988. 8 tab, 15 ref.

Descriptors: *Bioassay, *Water pollution effects, *Fathead minnows, *Sublethal effects, *Toxicity, Evaluation, Comparison studies, Embryonic growth stage, Larval growth stage, Animal growth, Survival, Effluents, Sodium pentachlorophenate, Sodium dodecylsulfate, Linear alkyl sulfonates, Industrial wastes, Chemical wastes, Chromium.

A study was conducted to evaluate and compare the fathead-minnow larval survival and growth test ('larval test') and the fathead-minnow embryo/larval survival and teratogenicity test ('embryo/larval test'). These tests were developed for use by the EPA regional and state programs and National Pollutant Discharge Elimination System permittees to estimate the chronic toxicity of effluents and receiving waters. Five larval tests with the reference toxicant, sodium pentachlorophenate (NaPCP), gave a mean subchronic value of 253 micrograms/l. The mean LC50, LC10, and LC1 values for the embryo-larval test were 313, 224, and 172 micrograms/l. The mean subchronic value for six larval tests with the reference toxicant, sodium dodecylsulfate (SDS), was 6.0 mg per l. The mean LC50, LC10, and LC1 values for the embryo-larval test were 5.8, 4.2, and 3.3 mg/l. The mean subchronic value for four larval tests with linear alkylbenzene sulfonate was 2.1 mg/l and the subchronic values ranged from 1.7 to 3.4 mg/l. The repeatability of the larval and the embryological tests with the reference toxicants, NaPCP and SDS, was excellent. As would be expected, the sensitivity of these two test methods varies with the toxicant. Side-by-side tests were conducted with two refinery effluents, one utility effluent, and with hexavalent chromium. The larval test was more sensitive to the refinery effluents and hexavalent chromium. The low test concentration of the utility effluent caused an adverse effect in both tests. (Author's abstract)
W89-01224

METALLOTHIONEIN-LIKE HEAVY METAL BINDING PROTEIN LEVELS IN ASIATIC CLAMS ARE DEPENDENT ON THE DURATION AND MODE OF EXPOSURE TO CADMIUM,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
For primary bibliographic entry see Field 5B.
W89-01228

5B. Sources Of Pollution

ROLE OF EXTERNAL AMMONIUM INPUTS IN FRESHWATER ACIDIFICATION,
Katholieke Univ. Nijmegen (Netherlands). Lab. of Aquatic Ecology.
J. A. A. Schuurkes, and R. Mosello.
Schweizerische Zeitschrift fuer Hydrologie SZHYA6, Vol. 50, No. 1, p 71-86, May 1988. 4 fig, 5 tab, 36 ref.

Descriptors: *Air pollution, *Acidification, *Water pollution sources, *Acid rain, *Ammonium, *Sulfates, *Nitrates, *Path of pollutants, Hydrogen ion concentration, Lakes, Rivers, Industrial emissions, Alpine regions, Italy, The Netherlands, Chemistry of precipitation, Precipitation.

Gaseous ammonia released into the atmosphere from animal manure, fertilizer and industrial processes neutralizes acid oxidation products of sulfur and nitrogen oxides in precipitation. This results in a substantial increase in pH of precipitation. Once deposited in soil or water, the ammonium compounds may be oxidized to nitric acid. This means that hydrogen ions neutralized in the atmosphere are now released. This paper concerns bulk precipitation samples at some selected northern Italian and Dutch sites, representing areas with different regional industrial and agricultural impact. In addition, the role of external loads of ammonium in freshwater acidification is discussed, considering an ammonium sulfate polluted subalpine lake in northern Italy and the results of experimental studies on susceptible soft water systems in The Netherlands. In these cases the acidifying effect of biochemical ammonium conversions, particularly ammonium oxidation, was evident, reaching pH values below 4. Regarding the deleterious chemical and ecological effects, a reduction in the emission of gaseous ammonia is programmed for The Netherlands. In the Alpine region atmospheric ammonia and ammonium also constitute a threat for sensitive ecosystems. (Author's abstract)
W89-00024

NATURAL DEGRADATION ABILITY OF LAKES AND THE ROLE OF DRAINAGE AREA IN THE PROCESS (OCENA NATURALNEJ PODATNOSCI JEZIOR NA DEGRADACJE I ROLA ZLEWNI U TYM PROCESIE),
Warsaw Univ. (Poland). Inst. of Physical Geographic Sciences.
For primary bibliographic entry see Field 2H.
W89-00032

INFLUENCE OF DUSTS FROM CHOSEN INDUSTRIAL PLANTS ON PARTICULAR LINKS OF FOREST ECOSYSTEM OF THE NIEPOLOMICE FOREST,
Akademia Rolnicza, Krakow (Poland). Faculty of Forestry.
For primary bibliographic entry see Field 5C.
W89-00081

CHEMISTRY OF ATMOSPHERIC PRECIPITATION IN THE BABIA GORA NATIONAL PARK,
Polish Academy of Sciences, Krakow. Zaklad Ochrony Przyrody i Zasobow Naturalnych.
E. Sawicka.
Ekologia Polska ELPLBS, Vol. 35, No. 2, p 431-448, 1987. 8 fig, 4 tab, 19 ref.

Descriptors: *Acid rain, *Chemistry of precipitation, *Path of pollutants, *Sulfur, *Poland, Cations, Heavy metals, Calcium, Magnesium, Sodium, Potassium, Zinc, Minerals, Rainfall, Chemical composition, Acidity, Chemical reactions, Nutrients, Water chemistry, Babia Goria National Park, Cycling nutrients, Water pollution sources.

Studies were conducted on the chemical composition of atmospheric precipitation during the vegetation seasons of 1981-1984 in the Babia Gora National Park, Poland, at various heights above sea level. It was found that: (1) the concentrations of sulfur, calcium, magnesium, sodium, potassium, and zinc varied greatly in different sampling areas; (2) in the majority of cases, the acidity of precipitation was below pH 5.6; (3) sulfur had the highest percentage in the total amount of mineral components, although the total amount of alkaline components was higher than that of sulfur and could neutralize it; (4) concentrations of nutrients in precipitation were sufficient to supply the demand for them by some plants, e.g., spruce; and (5) there was a high degree of correlation between the amount of rainfall and amount of sulfur, and also between the height of precipitation and the amount of magnesium. (Doria-PTT)
W89-00082

SOLUBILITIES OF TRACE COPPER AND LEAD SPECIES AND THE COMPLEXING CAPACITY OF RIVER WATER IN THE LINGGI RIVER BASIN,
Pertanian Malaysia Univ., Serdang. Dept. of Chemistry.
W. T. Tan, G. S. Tan, and I. S. A. N. Khan.
Environmental Pollution ENPOEK, Vol. 52, No. 3, p 221-235, 1988. 3 fig, 5 tab, 19 ref.

Descriptors: *Trace metals, *Copper, *Lead, *Chelation, *Rivers, *Solubility, *Path of pollutants, Metals, Heavy metals, Basins, River basins, Potentiometers, Chemical of composition, Water pollution sources, Voltammetry, Particulate matter, Tropical regims, Linggi River, Malaysia.

The physicochemical form and apparent metal complexing capacities of copper and lead species were studied in the river waters of the Linggi River Basin in Malaysia using anodic stripping voltammetry (ASV). These waters receive discharges from a palm oil mill and rubber processing factories, as well as some light industrial and urban discharges. The distribution patterns of various metal species and levels of metal-complexing capacities for copper and lead varied with the type of discharge. Discharges from light industries contained higher metal concentrations and have smaller complexing capacities, while discharges from agricultural industries and urban areas contained smaller amounts of metal but have higher complexing capacities. Metal species were predominantly found as particulate metals. The soluble metal fractions consisted of moderately labile and slowly labile fractions. The soluble copper and lead species were found mainly in the moderately labile and slowly labside fractions. The very labile species, though present in small amounts (on the order of 10 to the minus 8th power), can, over a long period of time, exert an impact in the receiving waters as these metal ions are readily bioavailable. (Doria-PTT)
W89-00084

CHEMICAL ENVIRONMENT OF SALVINIA MOLESTA MITCHELL: IONIC CONCENTRATIONS OF INFESTED WATERS,
Commonwealth Scientific and Industrial Research Organization, Indooroopilly (Australia). Div. of Entomology.
P. M. Room, and J. Y. Gill.
Aquatic Botany AQBODS, Vol. 23, No. 2, p 127-135, November 1985. 2 fig, 2 tab, 28 ref.

Descriptors: *Path of pollutants, *Aquatic plants, *Aquatic weeds, *Ions, *Salvinia, Anions, Cations, Nitrogen, Phosphorus, Wastewater lagoons, Australia, Chemical properties.

Concentrations of major anions and cations and of nitrate nitrogen, phosphate phosphorus, and total dissolved iron are reported for 6 sites in southeast Queensland, Australia. Samples collected from a lake during a 40-week period showed that concentrations of N, P, K, and Fe increased rapidly after rain, then decreased rapidly, probably due to uptake by Salvinia molesta. Concentrations of Na, Ca, Cl, and bicarbonate increased slowly during a prolonged dry spell and decreased rapidly after heavy rain. Ionic concentrations in the lake and in streams were similar to those reported from waters infested with S. molesta elsewhere. Concentrations in a sewage lagoon were generally far higher, but there were no indications of toxicity. Comparisons with uninfested waters suggest that S. molesta has not yet occupied all Australian freshwaters suitable for it. (See also W89-00111 and W89-00113) (Author's abstract)
W89-00106

NITROGEN POOLS AND SOIL CHARACTERISTICS OF A TEMPERATE ESTUARINE WETLAND IN EASTERN AUSTRALIA,
New South Wales Inst. of Tech., Broadway (Australia). School of Life Sciences.
P. J. Clarke.
Aquatic Botany AQBODS, Vol. 23, No. 3, p 275-290, December 1985. 7 fig, 3 tab, 34 ref.

Descriptors: *Path of pollutants, *Estuaries, *Wetlands, *Nitrogen cycle, *Aquatic soils, Temperate zone, Cycling nutrients, Organic carbon, Nitrogen compounds, Biomass, Oxidation-reduction potential, Hydrogen ion concentration, Mangrove swamps, Salt marshes, Australia, Nitrates, Nitritus.

The nitrogen status of the soil and plant components of an estuarine wetland near Sydney were investigated during a 6-month period to detect seasonal and spatial changes in nitrogen content. Organic carbon, organic nitrogen, and inorganic nitrogen concentrations were measured in the soil at various depths in six vegetation zones across the wetland. Carbon and nitrogen content of the plant biomass were also determined in each of the zones. Soil redox potentials and pH were measured in situ and both were found to vary with depth and inundation frequency. Organic carbon, organic nitrogen, and inorganic nitrogen in the soil decreased significantly from the fringe Casuarina forest (1391 g N/sq m) through to the Avicennia mangrove zone (133 g N/sq m). Exchangeable ammonium, nitrate, and nitrite concentrations form less than 1% of the soil nitrogen pool and vary seasonally. The distinctive feature of the mangrove zone is that the plant component of the total nitrogen pool is large (55%). This contrasts with the saltmarsh and fringe communities, where the plant pools are small (15%) in comparison with the soil. These findings are consistent with the hypothesis that mangroves export organic nutrients whereas the saltmarsh and fringe communities act as nutrient sinks. (Author's abstract)
W89-00110

USE OF MIRES IN MONITORING THE ATMOSPHERIC DEPOSITION OF HEAVY METALS,
National Water Research Inst., Burlington (Ontario). Aquatic Ecology Div.
For primary bibliographic entry see Field 5A.
W89-00123

WATER QUALITY OF THE TISZA RIVER AND THE ALPAR BACKWATER,
Csongrad County Public Health Station, Szeged (Hungary).
M. Hegedus, and I. Kajary.
Tiscia (Szeged), Vol. 20, p 3-12, 1985. 7 fig, 1 tab, 16 ref.

Descriptors: *Tisza river, *Alpar backwater, *Hungary, *Water quality, *Backwater, *Water pollution, *Water pollution effects, Salmonella, Pollution index, Similarity, Bacterial analysis.

The hygienic water quality of the Tisza backwaters at Csongrad and Alpar are reviewed on the basis of results of studies performed over a seven year period. The characterization of the sampling sites is given by means of a dendogram prepared on the basis of the Czekanovski similarity index. The Tisza river at Csongrad has become strongly polluted (water quality = III, and at places IV, class) in recent years. Over the past seven years, the water quality had fallen by one class due to great sewage-burden and the water barrage construction. The water quality of the backwater at Alpar was of I and II class and only rarely polluted in the majority of the study periods. The favorable water quality is probably caused by the fact that the backwater is not burdened considerably with sewage. Isolated salmonella serotypes are summarized. The preservation of the quality of the backwater as well as the more enhanced protection of the Tisza river by means of comparative microbiological studies are discussed. (Author's abstract)
W89-00143

RIVER EMS: PROCESSES AFFECTING THE BEHAVIOUR OF METALS AND ORGANOCHLORINES DURING ESTUARINE MIXING,
Nederlands Inst. voor Onderzoek der Zee, Texel.
J. C. Duinker, M. T. J. Hillebrand, R. F. Nolting, and S. Wellershaus.
Netherlands Journal of Sea Research NJSRBA, Vol. 19, No. 1, p 19-29, August 1985. 12 fig, 2 tab, 14 ref.

Descriptors: *River Ems, *The Netherlands, *Estuarine environment, *Path of pollutants, *Chlorinated hydrocarbons *Suspended sediments, *Metals, Tides, Neap tides, Copper, Zinc, Cadmium, Mixing, Sediments, Polychlorinated biphenyls, Manganese.

In summer 1976, measurements were made of the metals and organochlorines in solution and in suspension along with studies of transport and mixing of water and particulates in the freshwater and estuarine region of the river Ems during typical neap tide conditions. During observations, a fluid mud layer occurred on the bottom. The following properties were observed: (1) the mean grain size was greater than in other samples, and (2) the organic carbon content in seston was high, and consequently (3) dissolved oxygen concentrations in water were low. There was no difference in hexachlorocyclohexane contents between fluid mid-seston and other samples. Mn content in this seston was high and its leachable portion was the greatest in all samples. The behavior of other metals was different; contents were lower and their leachable portions were also lower than in other samples. Concentrations of Cu, Zn, and Cd in solution on the mixing zone were higher than in the fresh water and marine end members, probably as a result of land-based sources. Variations in mineral composition of suspended material in the longitudinal profile (S = 0 to 0.03) were minor. Variations in metal contents of suspended matter were interpreted in terms of variations in size/density properties. A wide range of PCB components was present in solution and suspension at concentrations in the pico- to nanogram per cu dm range. (Author's abstract)
W89-00149

NITRITE AND AMMONIA IN THE TAMAR ESTUARY,
Institute for Marine Environmental Research, Plymouth (England).
A. W. Morris, R. J. M. Howland, E. M. S. Woodward, A. J. Bale, and R. F. C. Mantoura.
Netherlands Journal of Sea Research NJSRBA, Vol. 19, No. 3/4, p 217-222, December 1985. 3 fig, 1 tab, 19 ref.

Descriptors: *Nitrites, *Path of pollutants, *Ammonia, *Tamar estuary, *England, *Estuaries, *Salinity, Turbidity, Sediment, Seasonal variation, Autoanalyzers, Dissolved oxygen, Oxygen depletion.

Seasonal variations in the axial distributions of nitrite and ammonia in the Tamar estuary, southwest England, have been recorded by continuous autoanalytical profiling at approximately monthly intervals together with measurements of salinity, turbidity and dissolved oxygen. In contrast to the persistent apparent conservatism of nitrite in this estuary, these reduced species of nitrogen have shown marked non-conservative behavior. Ammonia distributions generally showed a maximum in the middle to upper estuary which was variably located relative to salinity and had a magnitude which tended to vary with the spring-neap tidal condition. These maxima are attributed to releases from the sediment which are facilitated by tidal sediment disturbance. During the winter months, nitrite distributions reflected conservative mixing of riverine nitrite but internal inputs within the low salinity, turbidity maximum zone became increasingly significant from spring to late summer in phase with an increasing degree of local oxygen depletion. It appears that nitrite is generated within the water column by bacterially mediated oxidation of ammonia. Anthropogenic inputs significantly augment both constituents in the outer estuary. (Author's abstract)
W89-00154

NITROGEN BUDGET OF THE SCHELDT HYDROGRAPHICAL BASIN,
Universite Libre de Bruxelles (Belgium). Lab. d'Oceanographie.
G. Billen, M. Somville, E. DeBecker, and P. Servais.
Netherlands Journal of Sea Research NJSRBA, Vol. 19, No. 3/4, p 223-230, December 1985. 7 fig, 5 tab, 20 ref.

Descriptors: *Scheldt estuary, *Water pollution sources, *Path of pollutants, *Belgium, *Estuaries, *Denitrification, *Nitrogen cycle, Nitrites, Nitrates, Ammonium, Wastewater treatment, Organic nitrogen, Industrial wastewater, North Sea, Belgium, The Netherlands, Coastal waters, Water pollution control, Tertiary wastewater treatment, Belgian-Dutch coastal zone.

A nitrogen budget including nitrite, nitrate, ammonium and organic nitrogen is presented for the western Scheldt estuary. The nitrogen entering the estuarine zone was evaluated from measurements of NO2(-), NO3(-), NH4(+) and organic nitrogen concentration at Rupelmonde. The origin of this load in the Scheldt estuary was further investigated by the evaluation of the contribution of domestic, industrial sewages, agriculture and breeding n the nitrogenous load of the upper Scheldt drainage basin. Domestic load was evaluated from the watershed population. Industrial sewages were quantified by use of the evaluation of specific nitrogen spoilage by the various industries as a function of their number of workers. This work shows the predominant role of denitrification in tributaries of the drainage basin and in the estuary itself as a nitrogen sink, which reduces the amount of nitrogen exported by the Scheldt to the North Sea. It is suggested that the pursuit of the present wastewater treatment policy, only based on the elimination of the organic load without any tertiary treatment, could result in increasing the nitrogen output into the Belgian-Dutch coastal zones by a factor of 2 to 3. (Author's abstract)
W89-00155

MODELLING RESEARCH ON THE PRODUCTION CYCLE OF PHYTOPLANKTON IN THE SOUTHERN BIGHT OF THE NORTH SEA IN RELATION TO RIVERBORNE NUTRIENT LOADS,
Nederlands Inst. voor Onderzoek der Zee, Texel.
For primary bibliographic entry see Field 2L.
W89-00157

SOME HYDROCHEMICAL, HYDROBIOLOGICAL, AND ICHTHYOLOGICAL FEATURES OF YUGOSLAV PART OF THE DANUBE LASTING FOR SEVERAL YEARS (EINIGE HYDROCHEMISCHE, HYDROBIOLOGISCHE UND ICHTHYOLOGISCHE EIGENSCHAFTEN DER JUGOSLAWISCHEN DONAUSTRECKE IN MEHRJAHRIGEM ZEITRAUM),
Institute for Biological Research, Belgrade (Yugoslavia).
For primary bibliographic entry see Field 5C.
W89-00165

BACTERIAL DEGRADATION OF CRUDE OIL WATER POLLUTANTS IN DANUBE WATER (DIE BAKTERIELLE DEGRADATION VON ERDOLKOHLENWASSERSTOFFEN IM DONAUWASSER),
Slovenska Akademia Vied, Bratislava (Czechoslovakia). Ustav Experimentalenj Biologie a Ekologie.
B. Trzilova, and L. Miklosovicova.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 68, No. 3/4, p 343-350, May 1987. 4 fig, 2 tab, 12 ref. English summary.

Descriptors: *Oil pollution, *Rivers, *Biodegradation, *Microbial degradation, *Fate of pollutants, Bacteria, Pseudomonas, Hydrocarbons, Danube River, Water pollution.

Degradation of crude oil hydrocarbons by organotrophic bacteria as a whole, by bacteria of the genus Pseudomonas and by yellow and violet pigmented strains under experimental conditions in Danube water were studied. The groups of organotrophic bacteria were more sensitive to the presence of pollutants; this fact appeared as a decrease of the number of colonies and lower metabolic activity of the cells. Bacteria of the genus Pseudomonas and pigmented strains survived and multiplied even after 28 days exposition. The mineralizing ability showed dependence on the number, genus and physiological activity of bacteria. The examined bacterial groups degraded especially 9-19 carbon compounds. Aromatic components were degraded with higher intensity than the paraffins. (Author's abstract)
W89-00168

VIRAL POLLUTION OF SURFACE WATERS BY DOMESTIC WASTE WATER DISCHARGE (DIE VIRAL-VERUNREINIGUNG DER OBERFLACHENGEWASSER DURCH ABLEITEN DER HAUSHALTSABWASSER),
Institutul de Igiena si Sanatate Publica, Cluj-Napoca (Romania).
I. Nestor, L. Lazar, D. Sovrea, and N. Ionescu.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 68, No. 3/4, p 419-427, May 1987. 2 fig, 3 tab, 37 ref. English summary.

Descriptors: *Romania, *Danube River, *Water pollution sources, *Viruses, Enteroviruses, Wastewater disposal, Domestic wastes, Municipal wastes, Rivers, Coxsackie virus, Echovirus, Poliovirus.

The virological investigation of several surface waters from Romania (inland rivers Somes, Mures, Arges and the Danube River) carried out during he 1962-1980 period, showed a viral pollution of these waters with enteroviruses - vaccine strains of polioviruses, Coxsackie and echoviruses - in variable proportion, up to 50% (13, 17 and 18% on average) for the inland river samples and up to 41.7% (15% on average) for the Danube river water samples. Compared with different streams from other countries, the pollution of the investigated rivers was relatively low, owing to the treatment - even partial - of domestic wastewaters prior to their discharge into the stream. The ample hydrotechnical construction built during recent years along the main rivers, including the Danube, may contribute to a great extent to the self-purification of these waters. (Author's abstract)
W89-00170

RADIOACTIVITY OF THE CZECHOSLOVAKIAN REACH OF THE DANUBE RIVER (DIE RADIOAKTIVITAT IM TSCHECHOSLOWAKISCHEN DONAUABSCHNITT),
Vyskumny Ustav Vodohospodarsky, Bratislava (Czechoslovakia).
J. Mayer.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 68, No. 3/4, p 429-436, May 1987. 5 ref. English summary.

Descriptors: *Danube River, *Radioactivity, *Radioisotopes, *Czechoslovakia, *Sampling, Strontium, Cesium, Radium, Tritium, Radionuclides, Sediments, Aquatic flora, Aquatic fauna, Suspended solids, Czechoslovakia, Rivers.

Monthly water sampling and quarterly sediment sampling of the Czechoslovakian section of the Danube was performed. The following parameters were determined: alpha- and beta-activity, the contents of Sr-90, Cs-137, Ra-226 and H-3. The accumulation of radionuclides in biological samples (fauna and flora) from the Danube, as well as in the sediment and in the suspended matter, was also studied. The results show that the radioactivity level of this section of the Danube is low, consisting mostly of natural radionuclides. (Author's abstract)
W89-00171

IMPACT OF IMPOUNDING ON THE OXYGEN BALANCE OF THE DANUBE FROM KELHEIM TO JOCHENSTEIN MICROBIOLOGICAL-BIOCHEMICAL INVESTIGATIONS AND WATER QUALITY MODEL CALCULATIONS (ZUM EINFLUSS DER STRAUREGULIERUNG AUF DEN SAUERSTOFFHAUSHALT DER DONAUSTRECKE KELHEIM-JOCHENSTEIN: MIKROBIOLOGISCH-BIOCHEMISCHE UNTERSUCHUNGEN UND GUTEMODELLRECHNUNGEN),
Bundesanstalt fuer Gewaesserkunde, Koblenz (Germany, F.R.).
For primary bibliographic entry see Field 6G.
W89-00173

DETECTION AND ENUMERATION OF ACTINOMYCETES IN THE AUSTRIAN PART OF THE DANUBE BY MEANS OF SELECTIVE MEMBRANE FILTRATION METHODS TOGETHER WITH SOME OTHER BACTERIOLOGICAL PARAMETERS (NACHWEIS UND VORKOMMEN VON ACTINOMYCETEN IN DER OSTERREICHISCHEN DONAU MITTELS SELEKTIVER MEMBRANFILTERVERFAHREN, ZUSAMMEN MIT EINIGEN ANDEREN BAKTERIOLOGISCHEN PARAMETERN),
Bundesanstalt fuer Wasserguete, Vienna (Austria).
For primary bibliographic entry see Field 5A.
W89-00174

EFFECTS OF ACIDIFICATION AND PHOSPHORUS ADDITION ON PHYTOPLANKTON BIOMASS AND PRODUCTIVITY IN A CIRCUM-NEUTRAL MESOTROPHIC LAKE RECEIVING ACID PRECIPITATION,
West Virginia Univ., Morgantown.
For primary bibliographic entry see Field 2H.
W89-00179

MODEL ECOSYSTEMS AS A TOOL IN FRESHWATER AND MARINE RESEARCH,
National Swedish Environment Protection Board, Solna.
A. Lundgren.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 70, No. 2, p 157-196, April 1985. 9 fig, 1 tab, 144 ref.

Descriptors: *Microcosms, *Path of pollutants, *Ecosystems, *Model studies, *Food chains, *Toxicity, *Water pollution effects, *Fate of pollutants, Ponds, Lakes, Streams, Literature review, Bioassay.

This review surveys of recent studies in aquatic ecotoxicology and experimental ecology, where model ecosystems were used as test systems and is an attempt to provide both theoretical and practical aspects on the strategy of model ecosystem design. Small synthetic laboratory microcosms are easily replicated and well suited for standardization. Two examples are described representing the model ecosystem and the model food chain. These microcosms are characterized by a very simplified structure and a reduced number of biotic and abiotic interactions and cannot be regarded as models of any specific natural ecosystem. Experiments in small laboratory microcosms can, however, provide information on general ecosystem behavior and give quantitative on biodegradability of chemical substances, ecological magnification, etc. If information on fate and effects of toxic chemicals on more specific natural ecosystems is needed, much more complex model systems must be used. This is easiest done by isolating a part of a natural ecosystem. Different large-scale model ecosystems covering pelagic bags, benthos enclosures, enclosures of the profundal zone, combination enclosures with both benthic and pelagic communities and experimental ponds and lakes are described. The artifacts introduced by enclosure and scaling are discussed together with different ways to minimize their effects. The controversy between realism and replication is discussed and it is concluded that experiments in large-scale model ecosystems can provide valuable information on the fate and effects of pollutants in natural ecosystems. (Author's abstract)
W89-00180

NEW ASPECTS OF THE SULFUR CYCLE, WITH SPECIAL REFERENCE TO SHALLOW WATERS,
Hajdu-Bihar County Water Canalization Works, Debrecen (Hungary).
I. Devai, G. Devai, and I. Wittner.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 70, No. 4, p 534-579, August 1985. 8 fig, 135 ref.

Descriptors: *Sulfur cycle, *Shallow water, *Lakes, *Rivers, *Water pollution, *Path of Pollutants, Literature review, Wastewater disposal, Lake Balaton, River Zala, Hungary, Lake sediments, Chemical analysis.

Gas chromatographic and mass spectrometric investigations of the sediments in Lake Balaton, the River Zala and biomechanical combined oxidation-type sewage treatment plants indicated that the elementary sulfur content in these water bodies is much higher than was thought earlier. The literature on the different sulfur forms and the global sulfur cycle is reviewed, and in the framework of a new model the global sulfur cycle is discussed, taking into consideration the sulfur quantities in reservoirs and moving on the different fluxes. Possible pathways of elementary sulfur formation, biogeochemical transformations of sulfur compounds, and (based on the properties of shallow waters) the sulfur forms and the sulfur cycle in shallow waters are considered. (Author's abstract)
W89-00183

FACTORS AFFECTING NUTRIENT DYNAMICS IN A PIEDMONT NORTH CAROLINA RESERVOIR,
Duke Power Environmental Labs., Huntersville, NC.
For primary bibliographic entry see Field 2H.
W89-00187

BROMOTHYMOL-BLUE TEST: A SIMPLE ALGAL BIOASSAY AND ITS USE FOR HERBICIDE SCREENING,
Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Biotechnologie.
For primary bibliographic entry see Field 5A.
W89-00192

COULD BENTHIC ALGAE BE USED AS WATER QUALITY INDICATORS (KONNEN BENTHISCHE ALGEN ZUR WASSERGUTEBESTIMMUNG HERANGEZOGEN WERDEN),
Oesterreichische Akademie der Wissenschaften, Vienna. Biologische Station.
For primary bibliographic entry see Field 5A.

W89-00194

PRELIMINARY STUDY ON THE MIGRATION AND TRANSFORMATION OF HEAVY METALS IN THE SEWAGE-SEAWATER MIXING ZONE OF JINZHOU BAY, (IN CHINESE),
Institute of Marine Environmental Protection, Dalian (China).
B. Yongen, F. Yuzhong, and C. Zheling.
Oceanologia et Limnologia Sinica, Vol. 19, No. 2, p 140-148, March 1988. 5 fig, 6 tab, 2 ref. English summary.

Descriptors: *Bays, *Jirzhou Bay, *Heavy metals, *Wastewater, *Water pollution, *Path of pollutants, Wastewater seawater interface, Lead, Zinc, Cadmium, Organic compounds, Inorganic compounds, Tides, Advection, China, Metal complexes, Flushing, Solute transport.

The sewage-seawater mixing zone shifts with the tide in Jinzhou Bay. Therefore 2 interfacial mixing zones at high and low tide are formed. In the mixing zone at high tide, Pb, Zn and Cd exist mainly in soluble forms and tend to transfer from non-stable forms into bound forms, whereas Hg exists mainly in suspension and soluble organic Hg tends to change into inorganic Hg. In the mixing zone at low tide level, Pb, Zn and Cd exist mainly in soluble forms, but in these forms Pb and Cd tend to transfer from bound into non-stable forms, in opposition to their behavior at the high tide level, whereas Zn tends to change from non-stable forms to bound ones and Hg appears to change into the form bound by suspended grains. In a tidal period advection fluxes of these metals from the bay to out-bay are 2.772, 5.070 and 139.411 mg/sq m/h for Pb, Cd, and Zn, respectively. (Author's abstract)
W89-00199

CHARACTERISTICS OF DISTRIBUTION AND MIGRATION OF PHOSPHORUS IN DEPOSITS OF DIANCHI LAKE, (IN CHINESE),
Academia Sinica, Nanjing (China). Inst. of Geography.
Y. Yuansheng.
Oceanologia et Limnologia Sinica, Vol. 19, No. 2, p 149-156, March 1988. 4 fig, 3 tab, 6 ref. English summary.

Descriptors: *Dianchi Lake, *Eutrophication, *Eutrophic lakes, *Phosphorus, *Water pollution sources, *Industrial wastes, *Path of pollutants, Organic compounds, Calcium, Iron, Aluminum, Sediments, China, Water pollution sources, Sediment-water interfaces.

The average of total P is 0.523% (P2O5) in deposits of Dianchi Lake in the form of Ca-P compounds. There are two accumulation areas for horizontal distribution of total P. One source, the Haikou (the outlet of Dianchi Lake), is influenced mainly by the P source of Kunyang and closely related to industrial water pollution and organic enrichment in the swamp. The other source, the center of the lake, is closely related to the accumulation of inorganic clay. The vertical profile of total P shows that superficial sediments contain higher P than the lower natural beds. Valid P is mainly accumulated near the Haikou outlet owing to the influence of the industrial water pollution and accumulation of organic materials. The total P in the sediments is mainly found in Ca-P compounds, and the valid P is often in Fe-P and Al-P compounds. The mobility of Ca-P is small; Fe-P and Al-P are the main mobile states of the P compounds (except for soluble phosphate salts). All the layers of sediments below the surficial layer are in the reduced condition. The P gradually moves with downward water and is accumulated in the mud layer of sediments. The microaerophilic layer of sediments in water-sediment surface restrains P from being released from sediment to water, resulting in a much higher accumulation of P in the surficial layer than the other layers. The 27 layers of lignite and peat indicates that the lake has had several periods of eutrophication since the Cenozoic. Presently, the lake is a shallow lake or even a swamp at some places. Therefore, eutrophication is an inevitable result and accelerated by industrial pollution. Only by overall planning and limiting the small-sized reservoirs can the water level be maintained, and only by the conservation of aquatic plants can the ability of self-purification of the water body be restored and the process of eutrophication be slowed down. (Author's abstract)
W89-00200

CHEMICAL BEHAVIOR OF METAL ELEMENTS IN THE SEDIMENTS IN THE HANJIANG RIVER ESTUARY AND SHANTOU PORT, (IN CHINESE),
Academia Sinica, Guangzhou (China). South China Sea Inst. of Oceanology.
For primary bibliographic entry see Field 2L.
W89-00202

SOIL PROCESSES AND SULFATE LOSS AT THE HUBBARD BROOK EXPERIMENTAL FOREST,
Maine Univ., Orono. Dept. of Geological Sciences.
S. C. Nodvin, C. T. Driscoll, and G. E. Likens.
Biogeochemistry, Vol. 5, No. 2, p 185-199, 1988. 6 fig, 1 tab, 33 ref.

Descriptors: *Forests, *Forest soils, *Soil chemistry, *Forest watersheds, *Acid rain, *Geochemistry, *Sulfates, Acidic water, Stream discharge, Acidification, Adsorption, Deforestation, Hubbard Brook Ecosystem Study, New Hampshire, Cycling nutrients.

The Hubbard Brook Ecosystem Study (New Hampshire) was designed to evaluate element flux and cycling in a northern hardwood forest and the effects of disturbance on these processes. In the original experiment, an entire watershed was deforested and regrowth was inhibited for three years using herbicides. Initial effects of the treatment included: elevated stream discharge, large increases in streamwater solute concentrations and elevated losses of those ions from the watershed. In contrast, streamwater concentrations and net ecosystem output of sulfate decreased in response to the treatment. During the post treatment period, the concentrations of most dissolved ions declined relative to a reference watershed while, again in contrast, sulfate concentrations increased relative to the reference. A hypothesis is developed that links acidification and sulfate adsorption processes in the soil to explain the observed trends in sulfate losses from the Hubbard Brook Experimental Forest. (Author's abstract)
W89-00206

EFFECTS OF ACIDIFICATION ON METAL BUDGETS OF LAKES AND CATCHMENTS,
Ontario Ministry of the Environment, Dorchester. Dorset Research Center.
For primary bibliographic entry see Field 5C.
W89-00207

CYCLING OF INORGANIC AND ORGANIC SULFUR IN PEAT FROM BIG RUN BOG, WEST VIRGINIA,
Villanova Univ., PA. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W89-00208

DETERMINATION OF NAPHTHENIC ACIDS IN CALIFORNIA CRUDES AND REFINERY WASTEWATERS BY FLUORIDE ION CHEMICAL IONIZATION MASS SPECTROMETRY,
Shell Development Co., Houston, TX.
For primary bibliographic entry see Field 5A.
W89-00209

HYDROCHEMICAL STUDY OF LAKE SZCZYTNO MALE WITH TROUT CAGE CULTURE,
Wyzsza Szkola Nauczycielska w Slupsku (Poland). Dept. of Chemistry.
K. Korzeniewski, J. Trojanowski, and C. Trojanowska.
Polskie Archiwum Hydrobiologii PAHYA2, Vol. 32, No. 2, p 157-174, 1985. 6 fig, 9 tab, 8 ref.

Descriptors: *Water pollution sources, *Aquaculture, *Water chemistry, *Trout, *Szczytno Male Lake, *Lakes, *Limnology, Seasonal variation, Hydrology, Biochemical oxygen demand, Cycling nutrients, Dissolved oxygen,Limiting nutrients, Chemical analysis, Chemical properties.

In 1981 the influence of cage culture of trout on the hydrochemical and water-pollution conditions of Lake Szczytno Male was investigated. The chemical composition of the water was influenced most by the Brda River, which flows through the lake and completely changes its water every 2.5 days. Near the trout cages the saturation of water with oxygen decreased, while BOD5 suspended matter, dry residue, ammonia nitrogen, total nitrogen, phosphates and total phosphorus were higher. Numerical indices of water deterioration due to direct drainage and to the trout cage culture are presented. (See also W89-00237 thru W89-00240, W89-00256, and W89-00262) (Author's abstract)
W89-00241

CHEMICAL MECHANISMS OF HEAVY METAL TRANSPORT IN WATERS OF MALA PANEW AND BRYNICA RIVERS (SILESIA, POLAND),
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
M. Reczynska-Dutka.
Polskie Archiwum Hydrobiologii PAHYA2, Vol. 34, No. 1, p 7-23, 1987. 1 fig, 4 tab, 38 ref.

Descriptors: *Poland, *Mala Panew River, *Brynica River, *Path of pollutants, *Solute transport, *Heavy metals, Chemical analysis, Pollution load, Drainage systems, Industrial wastewater, Dams, Reservoirs, Rivers.

The linear correlations between heavy metal concentrations and concentrations of the major chemical components in waters in Mala Panew and Brynica rivers were analyzed. The effects of organic matter, Fe-Mn oxides, Ca and Mg carbonates, sulfates, nitrates, phosphate and chloride on heavy metal transport were investigated. The differences in the models of transport of heavy metals in both rivers, in the zone of atmospheric pollution, were found to be related to the influence of their drainage basins. Changes in the mechanisms of heavy metal transport with waters were caused in case of Mala Panew River by its loading with industrial waste waters, and in case of Brynica River by the presence of a dam and reservoir. (Author's abstract)
W89-00251

EFFECT OF DRAINAGE BASIN ON HEAVY METAL CONCENTRATIONS IN STREAM WATERS IN THE NIEPOLOMICE FOREST,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
M. Reczynska-Dutka.
Polskie Archiwum Hydrobiologii PAHYA2, Vol. 34, No. 2, p 267-281, 1987. 1 fig, 4 tab, 26 ref.

Descriptors: *Poland, *Niepolomice Forest, *Heavy metals, *Path of pollutants, *Acidification, Drainage systems, Decomposing organic matter, Aquatic habitats, Streams, Solute transport, Acidification, Hydrogen ion concentration, Flow, Poland, Acidic water, Drought, Forest streams, River flow.

In relatively dry years 1983-1984, the average dissolved heavy metal concentrations in waters of streams in the Niepolomice Forest were at or slightly above, and that of suspended heavy metals were slightly below, the average literature data for many waters. An increase in the concentrations of dissolved heavy metals is promoted by a high content of organic matter of natural origin in waters of woodland streams. Many significant correlations point to an upward trend in the concentrations of some heavy metals in water with an increase in flow and with water acidification. Water pH exhibits a significant downward trend with a rise of flow. (Author's abstract)

W89-00260

FACTORS FORMING THE LEVEL AND DYNAMICS OF NUTRIENT RUNOFF FROM AN AGRICULTURAL WATERSHED,
Institute of Meteorology and Water Management, Warsaw (Poland).
R. Taylor.
Polskie Archiwum Hydrobiologii PAHYA2, Vol. 34, No. 3, p 285-295, 1987. 4 fig, 5 tab, 7 ref.

Descriptors: *Eutrophication, *Nonpoint pollution sources, *Agricultural runoff, *Eutrophication, *Nonpoint pollution sources, *Path of pollutants, Solute transport, Physical properties, Water chemistry, Cycling nutrients, Hydrology, Fertilizers, Pollution load, Rivers, Poland, Krzeszowska Struga River, Catchment areas, Nutrients, Runoff.

In years 1981-1984 systematic studies were made of the influence of environmental conditions on formation of nutrient concentrations and runoff from the Krzeszowska Struga River basin (Poland). The dynamics and level of the concentrations of nutrients in the river are closely related to their physicochemical properties, which determined the transport routes of these substances from the watershed to river waters. Therefore, the amounts of outflowing nutrients depend on current contribution of different sources to total river inputs, and also are related to the volume of water participating in the nutrient washing-out process, i.e., to the meteorological and hydrological conditions in the watershed. Furthermore, the amounts and dates of application of inorganic fertilizers within the watershed greatly influence the level of nutrient loads carried by the river; critical conditions arise when fertilization is paralleled by occurrence of surface runoff. (Author's abstract)
W89-00261

DETERMINATION OF HEAVY METALS AT THE PG/G LEVEL IN ANTARCTIC SNOW WITH DPASV AND IDMS,
Regensburg Univ. (Germany, F.R.). Inst. fuer Anorganische Chemie.
For primary bibliographic entry see Field 5A.
W89-00270

CHERNOBYL 134CS, 137CS, AND 210PB IN HIGH MOUNTAIN LAKE SEDIMENT: MEASUREMENTS AND MODELING OF MIXING PROCESS,
Universite Scientifique et Medicale de Grenoble (France). Lab. de Spectrometrie Physique.
M. A. Melieres, M. Pourchet, J. F. Pinglot, R. Bouchez, and M. Piboule.
Journal of Geophysical Research (D) JGRDE3, Vol. 93, No. 6, p 7055-7061, June 1988. 5 fig, 1 tab, 10 ref, 2 append.

Descriptors: *Chernobyl accident, *Cesium radioisotopes, *Lead radioisotopes, *Pollutant identification, *Path of pollutants, *Lake sediments, Sediment transport, Model studies, Fallout, Lakes, Simulation, Sediments, Air pollution, Nuclear powerplants, France, Lake Lerie, Mountain lakes, Mixing.

Vertical distributions of 134Cs, 137Cs, and 210Pb were measured in a lake sediment core in Lake Lerie (French Alps). A value of 0.042 Bq/sq cm was estimated for the atmospheric 137Cs fallout originating in Chernobyl release on the Alpine area: it represents 15% of the residual 137 Cs activity due to nuclear tests. Mixing process and sedimentation rate were deduced from 134Cs and 210Pb distributions. Distribution of 137Cs was been simulated for slow and rapid mixing processes and for various mixing thicknesses. Comparison with the experimental distribution indicates values of mixing thickness and sedimentation rate in agreement with those previously measured. (Author's abstract)
W89-00271

CHANGES IN RAINWATER ACIDITY ASSOCIATED WITH CLOSURE OF A COPPER SMELTER,
Washington Univ., Seattle. Dept. of Civil Engineering.
R. J. Vong, L. Moseholm, D. S. Covert, P. D. Sampson, and J. F. O'Loughlin.
Journal of Geophysical Research (D) JGRDE3, Vol. 93, No. 6, p 7169-7179, June 1988. 10 fig, 6 tab, 24 ref. DOE Contract DE-AC06-76RL0-1830, Interagency Agreement EPA-DWA89930059.

Descriptors: *Smelters, *Washington, *Sulfur dioxide, *Chemistry of precipitation, *Path of pollutants, *Solute transport, *Acid rain, *Acidic water, Wind, Model studies, Statistical model, Regional analysis, Hydrogen ion concentration, Time series analysis, Air pollution effects, Tacoma, Sulfates, Copper.

The influence of the sulfur dioxide emissions from a large copper smelter in Tacoma, Washington, was studied by measuring the chemical composition of rainwater collected upwind and downwind of the source, before and after permanent closure of the smelter in 1985. Data analysis was based on a statistical model that accounted for variability associated with location of 25 sampling sites within three geographic regions, smelter operation, 10 individual rain events observed over 2 years, and measurement uncertainty. After smelter closure the upwind-downwind differences in mean hydrogen ion and excess sulfate ion concentrations within a 600 sq km region, extending to 25 km downwind of the source, had decreased significantly compared to the preclosure value. No significant decreases in mean ion concentrations were observed farther downwind in the Seattle urban area. During five events sampled prior to smelter closure, it is estimated that an average of 4.4% (range 0.7-8.6%) of the sulfur dioxide emitted by the smelter was wet deposited as sulfate ion within a 3600 sq km area extending 60 km downwind of the source. (Author's abstract)
W89-00272

EXCHANGE OF PHOSPHORUS BETWEEN A EUHALINE VEGETATED MARSH AND THE ADJACENT TIDAL CREEK,
South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology and Coastal Research.
T. G. Wolaver, and J. D. Spurrier.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 26, No. 2, p 203-214, February 1988. 4 fig, 4 tab, 19 ref. NSF Grant DEB 8119752.

Descriptors: *Path of pollutants, *Phosphorus, *Tidal creeks, *Marsh plants, Aquatic plants, Marshes, Vegetation, Tides, Tidewaters, Estuaries, Cycling nutrients, Salt marshes, Outwelling, Runoff.

Phosphorus exchange between a euhaline vegetated marsh and the adjacent tidal creek (North Inlet, South Carolina) was studied on 40 tidal cycles between 15 April 1983 and 19 June 1984. A flume was utilized to evaluate the net phosphorus exchange during tidal inundation, and a weir study was conducted to estimate the export of phosphorus from the marsh via runoff and seepage during low tide exposure (including storm events). Mean flood tide concentrations of PO4(3-) and particulate phosphorus (PP) faired seasonally between 0.1 and 1.3 microgram at. P/L and 0.3 to 2.8 micrograms at. P/L, respectively, with the highest values observed during the summer. PO4(3-) and PP were consistently removed from the tidal water inundating the marsh especially during the warmer months. There was a statistically significant alpha = 0.05) import of PO4(3-) and PP to the vegetated marsh during tidal inundation of 0.46 g P/sq m/yr and 2.01 g P/sq m/yr, respectively. For both constituents the removal rate on an areal basis was greater in the low marsh (tall Spartina alterniflora) than on the high marsh (medium and short S. alterniflora). The magnitude and direction of total phosphorus (TP) flux was similar to PP because the latter constituted up to 85% of the former. Export values of PO4(3-), PP, and Tp from the marsh via runoff and seepage during low-tide exposure (including rain events) were approximately 25% of the respective import values during tidal inundation. This study suggests a euhaline vegetated marsh is a sink for PO4(3-), PP, and TP and therefore may not be the source of phosphorus outwelled in many marsh-estuarine systems. (Author's abstract)
W89-00283

DISSOLVED MERCURY BEHAVIOUR IN THE SAINT LAWRENCE ESTUARY,
Centre Champlain des Sciences de la Mer (Quebec).
D. Cossa, C. Gobeil, and P. Courau.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 26, No. 2, p 227-230, February 1988. 1 fig, 17 ref.

Descriptors: *Mercury, *Saint Lawrence River, *Estuaries, *Path of pollutants, Heavy metals, Salinity.

Dissolved mercury concentrations have been measured in the waters of the St. Lawrence estuary. The typical concentration of the riverine endmember is 12.0 + or - 3.0 pm; the oceanic endmember samples exhibit a mean mercury concentration of 2.4 pm. The graphical pattern of the relationship between mercury concentration and salinity shows a departure from a dilution line. It is suggested that a removal of mercury from the dissolved phase during the estuarine mixing is responsible for this observation. Based on the results, the actual input of dissolved mercury from the St. Lawrence River to the Gulf is evaluated to be approximately 0.52 T/yr. (Author's abstract)
W89-00285

FIELD STUDY OF THE CLOUD CHEMISTRY AND CLOUD MICROPHYSICS AT GREAT DUN FELL,
University of Manchester Inst. of Science and Technology (England). Dept. of Physics.
A. S. Chandler, T. W. Choularton, G. J. Dollard, M. J. Gay, and T. A. Hill.
Atmospheric Environment ATENBP, Vol. 22, No. 4, p 683-694, April 1988. 12 fig, 2 tab, 18 ref.

Descriptors: *Acid rain, *Water pollution sources, *England, *Clouds, *Chemistry of precipitation, Great Dun Fell, Sulfur dioxide, Sulfates, Ozone, Oxidation, Hydrogen ion concentration, Hydrogen peroxide, Chemical reactions.

A series of experiments designed to investigate the oxidation of SO2 to sulfate by H2O2 and O3 are being performed in the cap cloud at Great Dun Fell; results of the first set of experiments are presented. These took place during November 1985. The aim of these experiments was to monitor the H2O2 oxidation process by measuring its depletion with time within the cloud in the presence of SO2. Increases in sulfate content of the cloud water were not observed during this experiment because H2O2 levels were too low and oxidation by O3 was inhibited by the low cloud water pH. The concentrations of aqueous phase H2O2 measured were typically 100 nmol and O3 gas phase concentrations 20 ppbv. In the presence of SO2, the concentration of H2O2 declined much more rapidly with height above cloud base than predicted by simple dilution by liquid water. On some occasions microphysical measurements in the cap cloud indicated that tropospheric air from above the cloud top was being entrained into the cloud. Increases in H2O2 concentrations with altitude within the cap cloud on these occasions showed that extra H2O2 was being simultaneously introduced to the cloud system. It is suggested that this entrainment process may play a very important role in SO2 oxidation in clouds when the reaction is oxidant limited. (Lantz-PTT)
W89-00308

ALIPHATIC AND POLYCYCLIC AROMATIC HYDROCARBONS IN URBAN RAIN, SNOW AND FOG,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
C. Leuenberger, J. Czuczwa, E. Heyerdahl, and W. Giger.
Atmospheric Environment ATENBP, Vol. 22, No. 4, p 695-705, April 1988. 4 fig, 5 tab, 34 ref.

Descriptors: *Aromatic compounds, *Hydrocarbons, *Rain, *Air pollution, *Path of pollutants, Switzerland, Snow, Fog, Alkanes, Organic compounds, Model studies, Molecular structure, Pollutant identification.

Rain, snow and fog samples have been collected at an urban site in Switzerland. Concentrations of n-alkanes and polycyclic aromatic hydrocarbons (PAH) were determined in the particulate (> or = 0.2 micrometers) and filterable phases. The n-alkanes in the particulate phase were characterized by a carbon preference index (CPI), in the range of C21-C33, or 7.1 in summer rain compared to 2.1 in winter rain. n-Alkanes with a CPI of 1.2 occurred in the filtrate of several samples. The presence of these highly water-insoluble n-alkanes in the filterable fraction suggests the formation of intermolecular associations (clusters, aggregates). The PAH patterns in the particulate phases resemble each other in snow, summer and winter rain, indicating similar sources and scavenging mechanisms. Variations in the concentrations of n-alkanes and PAH between seasons and between rain, snow and fog can be explained by the size of the associated particles and hydrometeors (rain droplet, snow flake, fog droplet) and the related scavenging efficiencies. The distribution coefficients obtained by field measurements have been applied to a scavenging model and to an equilibrium model taking hydrophobic partitioning into account. (Author's abstract)
W89-00309

TESTING A COMPREHENSIVE ACID DEPOSITION MODEL,
Ontario Ministry of the Environment, Rexdale.
A. Venkatram, and P. K. Karamchandani.
Atmospheric Environment ATENBP, Vol. 22, No. 4, p 737-747, April 1988. 7 fig, 1 tab, 9 ref.

Descriptors: *Acid rain, *Model studies, *Water pollution sources, Air pollution, Acid Deposition and Oxidant Model, Data interpretation, Sulfates.

The development and evaluation of a comprehensive acid deposition model referred to as ADOM (Acid Deposition and Oxidant Model) is described. The general approach to the formulation of the model and an evaluation of the model against observations collected during the OSCAR (April 1981) field study are presented. Although the model performs well in explaining the magnitudes and variations of the observations, the discrepancies between model predictions and observations are not small. Because of the uncertainties in the data used to run and evaluate the model, these discrepancies do not necessarily suggest the need for modifications in the model. Therefore, the direct comparison of model predictions with observations has been with indirect methods that establish the correspondence between the model and reality. Results from a base case simulation of two acid deposition episodes, with a comprehensive regional-scale model show that, for the most part, the model predicts expected features of the acid deposition system. Event-averaged concentrations of sulfate in rain are within a factor of two of the observations for 90% of the data for both episodes. (Lantz-PTT)
W89-00310

LEACHING OF RETORTED OIL SHALE: ASSESSING THE TOXICITY TO COLORADO SQUAWFISH, FATHEAD MINNOWS, AND TWO FOOD-CHAIN ORGANISMS,
Columbia National Fisheries Research Lab., MO.
For primary bibliographic entry see Field 5C.
W89-00329

MICROBIAL BIOMASS, ACTIVITY, AND COMMUNITY STRUCTURE OF WATER AND PARTICULATES RETRIEVED BY BACKFLOW FROM A WATERFLOOD INJECTION WELL,
Calgary Univ. (Alberta). Dept. of Biology.
V. L. McKinley, J. W. Costerton, and D. C. White.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 6, p 1383-1393, June 1988. 5 fig, 3 tab, 55 ref.

Descriptors: *Microorganisms, *Injection wells, *Aquatic habitats, *Microbiological studies, *Aquatic habitats, *Oil fields, Microbial analysis, Electron microscopy, Fatty acids, Particulate matter, Species composition, California, Biomass, Microbial analysis, Electron microscopy, Metabolism, Pollutant identification, Sampling.

Oil field injection water was allowed to back flow from two wells at the Packard drill site in Los Angeles, California, and was sampled at various times to obtain information about the biomass, potential activity, and community structure of the microbiota in the reservoir formation and in the injection water. Biomass was greatest in water samples that came from the zone near the injection site and dropped off sharply in subsequent samples, which were assumed to come from zones farther away from the well. Samples obtained from near the well also had visible exopolysaccharide blankets, as seen in scanning electron microscopic preparations. In one well rates of glucose or acetate incorporation into microbial lipids correlated with biomass; but in the other well, activities correlated with the sampling time (volume of water that back flowed). Transmission electron micrographs showed a diverse, gram-negative bacterial population in a variety of physiological states. The analyses of the phospholipid ester-linked fatty acid profiles of the samples revealed consistently large proportions of 18:1 omega 7c fatty acids, indicating the presence of many anaerobes, facultative organisms, or both. Proportions of cyclopropyl fatty acids and ratios of trans/cis monoenoic compounds increased with the volume of water back flowed (analogous with the distance into the formation), while the ratio of unsaturated/saturated compounds decreased, possibly indicating higher levels of stress or starvation in the microbial communities farthest from the injection well. Greater than 90% of the total biomass was trapped on glass fiber filters, indicating that the microbiota were largely attached to particles or were clumped. These sampling techniques and analytical methods may prove useful in monitoring for problems with microbes (e.g., plugging) in waterflood operations and in the preparation of water injection wells for enhanced oil recovery by the use of microbes. (Author's abstract)
W89-00334

INCIDENCE OF COLIPHAGE IN POTABLE WATER SUPPLIES,
National Research Centre, Cairo (Egypt). Water Pollution Control Lab.
For primary bibliographic entry see Field 5F.
W89-00338

EFFECTS OF CO-OCCURRING AROMATIC HYDROCARBONS ON DEGRADATION OF INDIVIDUAL POLYCYCLIC AROMATIC HYDROCARBONS IN MARINE SEDIMENT SLURRIES,
Maryland Univ., Solomons. Chesapeake Biological Lab.
J. E. Bauer, and D. G. Capone.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 7, p 1649-1655, July 1988. 7 fig, 1 tab, 41 ref. EPA Grant R809455011, NOAA grant Na-80-RAD 00057, and Hudson River Foundation Grant 14/83B/12.

Descriptors: *Fate of pollutants, *Hydrocarbons, *Mineralization, *Microbial degradation, *Biodegradation, *Marine sediments, Degradation, Benzene, Naphthalene, Anthracene, Carlson radioisotopes, Radioactive tracers, Phenanthrene, Selection, Ecology, Slurries.

Rates of polycyclic aromatic hydrocarbon (PAH) degradation and mineralization were influenced by preexposure to alternate PAHs and a nonaromatic hydrocarbon at relatively high (100 ppm) concentrations in organic-rich aerobic marine sediments. Prior exposure to three PAHs and benzene resulted in enhanced (C-14)naphthalene mineralization, while (C-14)anthracene mineralization was stimulated only by benzene and anthracene preexposure. Preexposure of sediment slurries to phenanthrene stimulated the initial degradation of anthracene. Prior exposure to naphthalene stimulated the initial degradation of phenanthrene, but had no effect on either the initial degradation or mineralization of anthracene. For those compounds which stimulated (C-14)anthracene or (C-14)naphthalene mineralization, longer preexposures (2 weeks) to alternate aromatic hydrocarbons resulted in an even greater stimulation response. Enrichment with individual PAHs followed by subsequent incubation with one or two PAHs showed no alteration in degradation patterns due to the simultaneous presence of PAHs. The evidence suggests that exposure of marine sediments to a particular PAH or benzene results in the enhanced ability of these sediments to subsequently degrade that PAH as well as certain other PAHs. The enhanced degradation of other PAHs after exposure to a single PAH suggests that the populations selected have either broad specificity for PAHs, common pathways of PAH degradation, or both. (Author's abstract)
W89-00339

MICROBIAL DEGRADATION OF XENOBIOTIC, AROMATIC POLLUTANTS IN HUMIC WATER,
Lund Univ. (Sweden). Dept. of Ecology.
P. Larsson, L. Okla, and L. Tranvik.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 7, p 1864-1867, July 1988. 3 fig, 21 ref.

Descriptors: *Microbial degradation, *Biodegradation, *Fate of pollutants, *Brown water lakes, *Aromatic compounds, *Chlorinated hydrocarbons, Lakes, Carbon radioisotopes, Mineralization, Humic acids, Radioactive tracers, Wastewater treatment.

The microbial degradation of a number of 14C-labeled, recalcitrant, aromatic pollutants, including trichloroguaiacol and di-, tri-, and pentachlorophenol, was investigated in aquatic model systems in the laboratory. Natural, mixed cultures of microorganisms in the water from a brown-water lake with a high content of humic compounds mineralized all of the tested substances to a higher degree than did microorganisms in the water from a clear-water lake. Dichlorophenol was the most rapidly degraded pollutant. The microbial species active in the degradation of pollutants in natural humic environments are probably not the same as those enriched from contaminated sites. Thus, the potential for natural microbial communities of essentially unpolluted humic lakes to degrade aromatic, chlorinated hydrocarbons should be of interest in more-applied aspects of the degradation of xenobiotic pollutants. (Author's abstract)
W89-00344

EVALUATION OF THE 'FUGACITY' (FEQUM) AND THE 'EXAMS' CHEMICAL FATE AND TRANSPORT MODELS: A CASE STUDY ON THE POLLUTION OF THE NORRSUNDET BAY (SWEDEN),
Senter for Industriforskning, Oslo (Norway).
K. Kolset, and A. Heiberg.
Water Science and Technology WSTED4, Vol. 20, No. 2, p 1-12, 1988. 3 fig, 10 tab, 19 ref.

Descriptors: *Fate of pollutants, *Model studies, *Model testing, *Pulp wastes, *Aquatic environment, Case studies, Wastes, Industrial wastes, Mills, Kraft mills, Environment, Estuarine environment, Flow, Bays, Sweden, Sediments, Suspended solids, Water pollution, Wastewater, Seawater, Chloroform.

Two different models were evaluated for predicting pollutant transport in an aquatic environment. The models, FEQUM (Fugacity EQUilibrium Model) and EXAMS, are presented and their characteristics explained and compared. In FEQUM, the concept of fugacity is considered as the driving force behind chemical transport. The EXAMS dispersion model uses water and sediment flow as the basis for calculating the dispersion of chemicals. FEQUM encompasses the whole environment, water, air, soil, sediments, suspended matter in water and biota, whereas EXAMS includes the aquatic domain only. Both models were applied to the Norrsundet Bay area on the east coast of

Sweden, polluted by kraft mill effluent. The models were calibrated using data on chloroform in wastewater and seawater, and then tested on four other pollutants present in the wastewater. Both models give satisfactory results for all compounds investigated except tetrachlorocatechol. Correlation coefficients between calculated and measured concentrations vary from 0.86 to 0.97. The poor results obtained for tetrachlorocatechol are probably due to the especially high affinity of this compound for suspended particles. (Author's abstract)
W89-00357

DISTRIBUTION OF CHLORINATED ORGANIC SUBSTANCES FROM PULP MILLS,
Uppsala Univ. (Sweden). Dept. of Hydrology.
L. Hakanson, P. Jonsson, B. Jonsson, and K. Martinsen.
Water Science and Technology WSTED4, Vol. 20, No. 2, p 25-36, 1988. 7 fig, 3 tab, 22 ref.

Descriptors: *Chlorinated hydrocarbons, *Path of pollutants, *Pulp wastes, *Bothnian Sea, Hydrocarbons, Wastes, Industrial wastes, Pulp and paper industry, Sediments, Erosion.

The spread of chlorinated organic substances (EOCl) from pulp mills in the sediments of the Bothnian Sea and the northern Baltic was investigated. It was found that (1) there is a clear linkage between the spread and concentration of EOCl in surficial sediments and the bottom dynamic conditions, such that high contents (highest 903 micrograms/g ds) generally appear close to the pulp mills and within areas of accumulation, and low contents (< 1 micrograms/g ds) appear in sediments from areas of erosion and transportation; (2) sediment core data indicate an ongoing increase in EOCl contamination; and (3) the concentrations of EOCl in sediments from lakes and coastal areas far from any known pulp mills are low. It is concluded that EOCl is distributed over vast areas and that it is hard or impossible to find any areas in the Bothnian Sea unaffected by these substances. (Doria-PTT)
W89-00359

INVESTIGATIONS OF CHLORINATED THIOPHENES: A GROUP OF BIOACCUMULABLE COMPOUNDS IDENTIFIED IN THE EFFLUENTS FROM KRAFT BLEACHING,
Senter for Industriforskning, Oslo (Norway).
G. E. Carlberg, S. Johnsen, L. H. Landmark, B. E. Bengtsson, and B. Bergstrom.
Water Science and Technology WSTED4, Vol. 20, No. 2, p 37-48, 1988. 4 fig, 4 tab, 20 ref.

Descriptors: *Sulfur compounds, *Chlorinated hydrocarbons, *Bleaching wastes, *Path of pollutants, *Fate of pollutants, *Bioaccumulation, *Thiophenes, Hydrocarbons, Wastes, Industrial wastes, Effluents, Accumulation, Toxicity, Water pollution effects, Fish, Indicators, Tracers, Environmental tracers, Crustaceans.

The structure, bioaccumulation potential, and toxicity of chlorinated thiophenes from bleaching wastes were investigated. By comparison with six synthesized standards, the identity of the following chlorinated thiophenes was established in spent kraft bleach liquors: 2,3,4-trichlorothiophene and 3-formyl and 3-acetyl di- and trichlorothiophene. The synthesized standards were found to be isomers of the thiophenes identified in the effluents. A large number of lipophilic terpene derivatives with from one to four chlorine atoms were also detected. The synthesized chlorinated thiophenes were found to have partition coefficients (Log Pow) between 3.8 and 5.6. The compounds were found to bioaccumulate in bleak (Alburnus alburnus). About one third of the concentrations at the end of the exposure period remained in the fish after an elimination period of 14 days. The compounds were moderately toxic towards the crustacean Nitocra spinipes. Three of the compounds showed mutagenic activity. It is concluded that chlorinated thiophenes can probably be used as environmental tracers for organochlorine compounds formed from pulp bleaching, since these compounds are both lipophilic and fairly persistent. (Author's abstract)
W89-00360

ENVIRONMENTAL FATE OF CHLOROGUAIACOLS AND CHLOROCATECHOLS,
Swedish Environmental Research Inst., Stockholm.
A. S. Allard, M. Remberger, T. Viktor, and A. H. Neilson.
Water Science and Technology WSTED4, Vol. 20, No. 2, p 131-141, 1988. 7 fig, 6 tab, 14 ref.

Descriptors: *Fate of pollutants, *Chlorinated hydrocarbons, *Biotransformation, *Microbial degradation, Hydrocarbons, Biodegradation, Bacteria, Aerobic bacteria, Anaerobic bacteria, Sediments, Environment, Aquatic environment, Metabolism, Microbiological studies, Biological magnification, Fish, Toxicity.

An account is given of microbial transformations of chloroguaiacols and chlorocatechols. Experiments were carried out with pure cultures of aerobic bacteria and endogenous anaerobic bacteria in contaminated samples of sediment. Particular attention was directed to the role of environmental parameters in determining the fate of compounds discharged into the aquatic environment and to the potentially toxic effects of metabolites. An attempt has been made to assess the environmental significance of the results of laboratory experiments, and the data incorporated into a hypothetical 'guaiacol cycle.' (Author's abstract)
W89-00369

FATE OF SPENT BLEACH LIQUOR MATERIAL IN RECEIVING WATERS: CHARACTERIZATION OF CHLOROORGANICS IN SEDIMENTS,
Svenska Traeforskningsinstitutet, Stockholm.
F. de Sousa, L. M. Stromberg, and K. P. Kringstad.
Water Science and Technology WSTED4, Vol. 20, No. 2, p 153-160, 1988. 5 fig, 2 tab, 19 ref.

Descriptors: *Fate of pollutants, *Bleaching wastes, *Pollutant identification, *Chlorinated hydrocarbons, *Sediments, Wastes, Industrial wastes, Hydrocarbons, Solvents, Oxidation, Degradation, Biodegradation, Phenols.

Sediments collected at various distances from pulp mills producing bleached chemical pulp were characterized with respect to the presence of chlorinated material extractable by hexane/isopropanol. Also the presence of chlorinated high molecular weight material from spent bleach liquors was investigated by oxidative degradation. The results show that the major part of the hexane/isopropanol soluble material in sediments differs from that in spent bleach liquors. This suggests that this material originates from sources other than spent bleach liquors or is formed by chemical and/or biological transformations of such material. However, the sediments do contain small quantities of chlorinated phenolic compounds and high molecular weight material originating from spent bleach liquors. (Author's abstract)
W89-00371

CONTRIBUTION OF PLASMIDS TO NAPHTHALENE CATABOLISM IN SEDIMENT BACTERIA,
University of Wales Inst. of Science and Technology, Cardiff.
M. J. Day, N. F. Burton, and A. T. Bull.
Letters in Applied Microbiology, Vol. 6, No. 4, p 75-78, April 1988. 2 fig, 1 tab, 10 ref. United Kingdom Science and Engineering Research Council Grant GR/B23229.

Descriptors: *Biodegradation, *Plasmides, *Naphthalene, *Aquatic bacteria, *Fate of pollutants, Path of pollutants, Sediments, Bacterial genetics, Coking plants, Rivers, Reproduction.

Naphthalene utilizing bacteria were isolated from several sites above and below the discharge from a coking plant. The distribution of the bacteria was influenced by the effluent. Of these isolates, 11.4% obtained from the effluent discharge site contained plasmids. No conjugal transfer of naphthalene utilizing ability was observed in over 1000 matings. Curing and transformation experiments demonstrated that one plasmid pNB33 (101 kb) was concerned with naphthalene catabolism. (Author's abstract)
W89-00378

MODELLING OF FLOW THROUGH POTASH TAILINGS PILES,
Saskatchewan Univ., Saskatoon. Dept. of Civil Engineering.
D. K. H. Wong, S. L. Barbour, and D. G. Fredlund.
Canadian Geotechnical Journal CGJOAH, Vol. 25, No. 2, p 292-306, May 1988. 5 fig, 2 tab, 23 ref.

Descriptors: *Leaching, *Groundwater movement, *Path of pollutants, *Potash, *Mine wastes, Brine, Permeability coefficient, Mathematical models, Simulation analysis, Computer programs, Infiltration, Model studies, Flow profiles, Simulation.

Modelling the flow of brine through potash tailings requires that the saturated and unsaturated hydraulic properties of the tailings be established; in particular, the relationships of fluid content and permeability to matric suction are required. The in situ and laboratory testing techniques used for determining these properties are described and the results are presented. Numerical modelling techniques for the flow of brine through potash tailings are demonstrated by performing a computer simulation of an open-trench infiltration test were compared with the results of the simulation. The simulation utilizes the measured fluid content versus suction curves and the calculated permeability versus suction curves as input parameters. Good agreement was observed between the measured and simulated field responses. The effects of varying the hydraulic properties of the tailings are examined to arrive at a better understanding of the flow mechanism involved. (Author's abstract)
W89-00388

BIOCHEMICAL COMPOSITION OF THE BLUE CRAB CALLINECTES SAPIDUS EXPOSED TO THE WATER-SOLUBLE FRACTION OF CRUDE OIL,
Louisiana State Univ., Baton Rouge. Dept. of Zoology and Physiology.
For primary bibliographic entry see Field 5C.
W89-00391

SUMMARY OF REPORTED FISH KILLS IN KANSAS DURING 1982,
Kansas Fish and Game Commission, Pratt. Fisheries Div.
For primary bibliographic entry see Field 5C.
W89-00393

SOIL SOLUTION IN A SOIL TREATED WITH DIGESTED SEWAGE SLUDGE,
Oxford Univ. (England). Soil Science Lab.
D. J. Campbell, and P. H. T. Beckett.
Journal of Soil Science JSSCAH, Vol. 39, No. 2, p 283-298, June 1988. 3 fig, 5 tab, 54 ref.

Descriptors: *Path of pollutants, *Sludge disposal, *Soil solution, *Trace metals, *Soil treatment, *Sludge, Wastewater disposal, Soil samples, Chemical analysis, Hydrogen ion concentration, Organic carbon, Nitrites, Sulfates, Magnesium, Calcium, Strontium, Boron, Barium, Copper, Zinc, Fate of pollutants.

Toxic trace metals may percolate to the groundwater from sewage sludge disposed onto land. Analysis are presented of the soil solution from a slightly acid loamy soil treated 7 years earlier with single applications of digested sewage sludge in amounts equivalent to 0, 150 and 330 T dry matter/ha. These very heavy dressings correspond to 2 and 4.5 times the recommended 30-year limit. Samples of soil and soil solution from four depths to 80 cm were analyzed for Al, B, Ba, Ca, Cl, Cu, Fe, K, Li, Mg, Mn, Na, Ni, P, S, Sr, V, Zn, together with the organic matter of the soil, and

the pH, alkalinity dissolved organic carbon, and absorbance at 350 nm of the solutions. These very heavy sludge applications were apparently still releasing substantial quantities of NO3, and some SO4 even after 7 years. Nitrate, SO4, Mg, Ca, Sr, B, and possibly Ba are still moving through the profile, possibly to the groundwater. Solution concentrations of Cu and Zn are considerably higher at all depths than those in the untreated plot, but they fall off sharply with depth. It is unlikely that any Cu or Zn is now reaching the groundwater. (Author's abstract)
W89-00413

SEASONAL AND TEMPORAL CHANGES OF ORGANIC COMPOUNDS IN RAIN AND SNOW,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
J. Czuczwa, C. Leuenberger, and W. Giger.
Atmospheric Environment ATENBP, Vol. 22, No. 5, p 907-916, May 1988. 5 fig, 4 tab, 25 ref.

Descriptors: *Organic compounds, *Alkylbenzene sulfonates, *Hydrocarbons, *Water pollution sources, *Chlorinated hydrocarbons, *Chemistry of precipitation, Urban areas, Rain, Snow, Switzerland, Air pollution, Precipitation.

Alkylbenzenes, polycyclic aromatic hydrocarbons and chlorinated hydrocarbons were determined in rain and snow collected during 1985 at an urban site in Switzerland. Although great variations in concentrations were found for each season and type of precipitation event, concentrations and wet depositions of the investigated compounds were significantly lower in summer than in winter precipitation. Snow contained the highest concentrations of alkylbenzenes, i.e., total concentrations of up to 10 microgm/l. Non-polar organic chemicals, measured sequentially during three rain events, exhibited a variety of temporal trends that can best be explained by changing sources and moving air masses. (Author's abstract)
W89-00429

RAIN-AEROSOL COUPLING IN URBAN AREA: SCAVENGING RATIO MEASUREMENT AND IDENTIFICATION OF SOME TRANSFER PROCESSES,
Paris-7 Univ. (France). Lab. de Physico-Chimie de l'Atmosphere.
For primary bibliographic entry see Field 2B.
W89-00430

ATMOSPHERIC DEPOSITION OF ARSENIC AND ASSOCIATION WITH ACID PRECIPITATION,
Delaware Univ., Lewes. Coll. of Marine Studies.
J. R. Scudlark, and T. M. Church.
Atmospheric Environment ATENBP, Vol. 22, No. 5, p 937-943, May 1988. 4 fig, 1 tab, 41 ref.

Descriptors: *Acid rain, *Arsenic, *Chemistry of precipitation, *Water pollution sources, *Pollutant identification, Air pollution, Sulfates, Nitrates, Chemical reactions, Deposition, Tracers.

Measurements of As concentration and speciation in acid precipitation events were conducted at the mid-Atlantic coast of the U.S. for the period June 1985-October 1986. Only inorganic As was detected, in concentrations ranging from < 0.01 to 14.95 nmol/l with an annual volume-weighted mean of 1.30 nmole/l. The total As concentration exhibited a positive correlation with acidity, excess (non-seasalt) sulfate, and nitrate, suggesting common atmospheric sources and fates from fossil fuel combustion. Contributions of As from marine sources appear to be minor. Reduced As (III) comprise between 0 and 40% of the total in selected events; the As(III)/(V) ratio may be indicative of the redox intensity (pE) and/or source of the associated storm system. Based on concurrent bulk (wet plus dry) collections, the total As deposition rate varied from 42.7 to 296 nmole/sq m/mo, with dry deposition estimated to comprise between 29 and 55% of the total. (Author's abstract)
W89-00431

SHORT-TERM TRENDS IN SULFATE DEPOSITION AT SELECTED BULK PRECIPITATION STATIONS IN NEW YORK,
R. M. Hirsch, and N. E. Peters.
Atmospheric Environment ATENBP, Vol. 22, No. 6, p 1175-1178, June 1988. 2 fig, 7 ref.

Descriptors: *Trends, *Sulfates, *Pollutant identification, *New York State, *Acid rain, Data collections, Statistical studies, Deposition, Chemistry of precipitation, Precipitation.

Trends in rainfall-adjusted sulfate concentration were assessed for 5-yr subrecords of the 14.5-17 yr of monthly bulk-deposition data from five stations in New York by using the seasonal Kendall test. For the 5-yr subrecord from 1978 to 1982, the trends from the bulk deposition were similar to those for weekly wet-only deposition for adjacent stations of the National Atmospheric Deposition Program (NADP). The long-term trend at each of the bulk-precipitation sites was downward and statistically significant at $P < 0.02$, whereas 26% of the 69 subrecords had trends that were statistically significant only at $P < 0.2$. Of these statistically significant subrecord trends, 10% were positive (opposite to the long-term trend). Furthermore, the slopes of the subrecord trends tended to be much steeper than those of the whole record. These 5-yr trends, consequently, are poor indicators of the trends that occur over much longer periods in the same record. (Author's abstract)
W89-00432

COMPARISONS OF RADM AND OSCAR PRECIPITATION CHEMISTRY DATA,
State Univ. of New York at Albany. Atmospheric Sciences Research Center.
P. Middleton, J. S. Chang, J.C. del Corral, H. Geiss, and J. M. Rosinski.
Atmospheric Environment ATENBP, Vol. 22, No. 6, p 1195-1208, June 1988. 3 fig, 3 tab, 25 ref.

Descriptors: *Model studies, *Acid rain, *Chemistry of precipitation, *Water analysis, *Sulfates, *Nitrates, Comparison studies, Air pollution, Chemical analysis, Data analysis, Precipitation, Rainfall, Deposition.

The relationships between predictions of the Regional Acid Deposition Model (RADM) and observed precipitation chemistry patterns associated with frontal storm systems were examined. Three episodes, monitored as part of the Oxidation and Scavenging Characteristics of April Rains (OSCAR) program and referred to as OSCAR I, OSCAR II and OSCAR IV, were analyzed. The temporal and spatial variations of chemical concentrations in rainfall and deposition of SO4(2-), NO3(-), H(+), and NH4(+), as well as rainfall amounts observed, at up to 36 stations, were compared with the corresponding RADM grid-average predictions. The comparison database is limited by incomplete chemical data for all of the events and some ambiguity regarding the station operation during OSCAR II. The analysis is further complicated by the fact that grid averages are not necessarily representative of point measurements when the measurements are strongly influenced by local phenomena. Quantitative comparisons for each grid-point pair were made using average fractional differences, which are defined as the difference in the observations and predictions divided by the sum of the observations and predictions. For OSCAR IV the SO4(2-) and NO3(-) wet depositions generally were within a factor of 1.1-1.6 agreement's with better than a factor of 1.1 agreement for about one-fifth of the pairs compared. For all of the events, agreement of a factor of two or better generally was associated with good agreement for the ion concentrations in rainfall and the rainfall amounts, in regions of high deposition and at locations less influenced by potential errors in initialization of the RADM simulation. The best agreement for all of the cases was found for SO4(2-) deposition. The accuracy of the precipitation predictions was found to be the major determinant of the deposition agreement. Another suspected factor is the degree to which the grid average rainfall patterns are representative of the point measurements, but the importance of this factor is difficult to establish. (Author's abstract)
W89-00433

EFFECTS OF DISTURBANCES ALONG HYDROELECTRICAL TRANSMISSION CORRIDORS THROUGH PEATLANDS IN NORTHERN MANITOBA, CANADA.
Rannsoknastofnun Landbunadarins, Reykjavik (Iceland).
For primary bibliographic entry see Field 4C.
W89-00436

SENSITIVITY OF CORAL REEFS TO ENVIRONMENTAL POLLUTION,
Humboldt-Univ. zu Berlin (German D.R.). Museum fur Naturkunde.
For primary bibliographic entry see Field 5C.
W89-00440

DEPRESSED MERCURY LEVELS IN BIOTA FROM ACID AND METAL STRESSED LAKES NEAR SUDBURY, ONTARIO,
B.A.R. Environmental, Toronto (Ontario).
C. D. Wren, and P. M. Stokes.
Ambio AMBOCX, Vol. 17, No. 1, p 28-30, 1988. 4 fig, 27 ref.

Descriptors: *Water pollution effects, *Mercury, *Fish, *Acid rain, *Heavy metals, *Toxicity, *Aquatic animals, Population exposure, Lakes, Industrial wastes, Selenium, Crayfish, Perch.

Recent studies have suggested that mercury levels in fish are elevated in acidic lakes. A study was conducted to determine if negative relationships between lake pH and fish mercury content, which have been reported for several areas, are consistent over a wide range of lake conditions. Samples of crayfish, fish, mink and otter from different sites in Ontario, Canada, were analyzed for total mercury and selenium in some tissues. Concentrations of mercury were lowest in specimens from watersheds near the smelters at Sudbury. Crayfish mercury levels displayed a positive correlation with lake pH. Crayfish and perch mercury levels increased linearly with distance from Sudbury. It is suggested that selenium, and possibly other heavy metals emitted from the smelters, are inhibiting mercury methylation and uptake by aquatic biota in lakes near Sudbury. (Author's abstract)
W89-00442

CONCENTRATIONS OF TRACE METALS IN THE QIANTAGN-JIANG RIVER AND ITS ESTUARY IN SOUTHERN CHINA,
Institut de Biogeochimie Marine, Montrouge (France).
J. Zhang, and W. Huang.
Ambio AMBOCX, Vol. 17, No. 1, p 36-39, 1988. 4 fig, 4 tab, 18 ref.

Descriptors: *China, *Trace elements, *Estuaries, *Copper, *Cadmium, *Nickel, *Lead, *Chromium, *Qiantagn River, Desorption, Path of pollutants, Particulate matter, Pollutant identification, Dissolved organic matter.

Levels of particulates of five trace elements, copper, cadmium, nickel, lead and chromium were determined at seven sites along the Qiantang-jiang River and in its estuary. Results indicated that concentrations of trace-metal particulates are related to those of suspended matter. Concentrations of these elements were higher in the river than in the estuary and can be related to the diluting effect of the incoming water that contains high levels of suspended matter and to the desorption process. Atmospheric transportation can play an important role in the environmental cycling of trace metals. This is reflected in the EF-values (EF value = (concentration on microsurface/concentration in subsurface layers) - 1.0) determined for the Qiantang-jiang River. The higher EF values for Pb, Cd and Ni are probably related to atmospheric transportation. Complexing with organic matter was perhaps the most important causal factor for the high EF value found for copper. Chromium was less concentrated in the microsurface compared to the other elements investigated. (Author's abstract)

W89-00443

CHANGES IN SOIL ACIDITY IN TWO FOREST AREAS WITH DIFFERENT ACID DEPOSITION: 1920S TO 1980S,
Sveriges Lantbruksuniversitet, Uppsala. Inst. foer Ekologi och Miljoevaard.
C. O. Tamm, and L. Hallbacken.
Ambio AMBOCX, Vol. 17, No. 1, p 56-61, 1988. 3 fig, 3 tab, 35 ref.

Descriptors: *Acid rain, *Water pollution sources, *Forest soils, *Soil horizons, *Soil chemistry, Climatology, Soil organic matter, Forests, Forest hydrology, Coniferous forests.

Changes in acidity that occurred from the period 1926-27 until the period 1982-85 in stands of different ages in two areas with different acid deposition load and different forest history are compared. The relative roles of tree species, stand age, and acid deposition for soil acidification are discussed. Soil horizons in two forest areas with different climate, history and acid deposition load were examined electrometrically for acidity in 1926-27 and re-examined in 1982-85. The deeper soil horizons beneath coniferous stands were already more acid in southwestern Sweden than those in northern Sweden in 1926-27. The new pH measurements indicate that the recent rate of acidification is higher in the southwestern than in the northern sites. There is no evidence that existing differences in forest history, climate, or soil mineralogy would explain this difference. The most likely explanation is the difference in acid deposition load. (Author's abstract)
W89-00444

RAIN ACIDITY IN STELLENBOSCH,
For primary bibliographic entry see Field 5A.
W89-00454

REGIONAL HYDROGEOLOGY OF AGRICULTURAL DRAINAGE WELLS IN IOWA,
Iowa Univ., Iowa City. Dept. of Geology.
L. Drake, and S. Esling.
Geological Society of America Bulletin BUGMA, Vol. 100, No. 7, p 1131-1139, July 1988. 6 fig, 5 tab, 39 ref. EPA Grant G007165-01.

Descriptors: *Geohydrology, *Path of pollutants, *Agricultural runoff, Drainage wells, *Iowa, Aquifers, Tile drainage, Surface runoff, Injection wells, Surface-groundwater relations, Model studies, Nitrogen compounds, Fertilizers, Contaminant plumes, Effective porosity, Groundwater movement, Disposal wells, Flow velocity.

In Iowa, agricultural drainage wells (ADWs) represent the largest deliberate transfer of degraded water into major aquifers. An estimated 700 ADWs remove tile and surface waters from level farmland and inject it into underlying aquifers. Of 174 field-identified ADWs, 165 were grouped into 3 clusters in north-central Iowa (17 in Floyd County, 44 in Wright County, and 104 in Humbolt-Pocahontas Counties). Geologically, most of the identified ADWs penetrate the Des Moines glacial lobe and discharge into carbonate aquifers. These aquifers are in the intermediate groundwater flow regime, with recharge mainly from the overlying landscape and discharge mainly to rivers. A graphic flow-net model indicates a progressive increase in recharge downgradient, providing increased dilution for contaminants. Modeling suggests that tile-line drainages have averaged about 10-12 ppm nitrate-N during the past decade, mostly derived from fertilizer applications. ADW effluents measured during Spring 1983 ranged between 10 and 20 ppm nitrate-N. Plumes associated with ADWs would contain nitrate-N in concentrations approaching 20 ppm near the source, decreasing downgradient to 2-6 ppm with groundwater mixing. Joint and bedding-plane openings in the carbonate aquifer formations were measured in quarries, and the effective porosities were about 1%. If it is assumed that diffuse flow approximates isotropic and homogeneous conditions, groundwater-flow velocities range from 500 to 26,000 ft/yr. Residence times for groundwater in the carbonate aquifers range from a few months to a few decades, depending on the groundwater velocity and the length of individual flow paths. (Author's abstract)
W89-00471

MODIFIED FICKIAN MODEL FOR SOLUTE UPTAKE BY RUNOFF,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Mining, Environmental and Geological Engineering.
C. P. Richardson, and A. D. Parr.
Journal of Environmental Engineering (ASCE) JOEDDU, Vol. 114, No. 4, p 792-809, August 1988. 7 fig, 4 tab, 20 ref. Kansas Water Resources Research Institute Project G1226-04 and University of Kansas GRF Award 87-113.

Descriptors: *Agricultural runoff, *Path of pollutants, *Soil water, *Fickian model, *Solute transport, *Entrainment, Interstitial water, Overland flow, Mass transfer, Diffusion coefficient, Permeability, Data interpretation, Hydrologic models, Graphical methods, Diffusion.

A one-dimensional Fickian diffusion model for entrainment of interstitial soil water by overland flow was modified to account for early non-Fickian mass transfer observed during laboratory runoff experiments. Modification involves specifying a time-dependent diffusion coefficient that decreases with time and asymptotically approaches the constant Fickian value with time. Results show that this asymptotic diffusion coefficient varies with the square of the quantity ((shear velocity) times the square root of (media permeability)). Modifying the model entails the development of type curves for a range of convective time scales, or times of non-Fickian mass transfer. A graphical curve-matching technique using dimensionless cumulative mass-loss data provides a means of estimating the entrainment, or mass transfer, coefficient as a function of the convective time scale. This procedure shows that the entrainment coefficient varies linearly with ((shear velocity) times the square root of (media permeability)). Reasonable prediction of mass loss results using the asymptotic diffusion coefficients, an empirical relationship for the entrainment coefficient, and a convective time scale of 5 minutes as model input. (Author's abstract)
W89-00486

ANALYSIS OF TURBULENT BUOYANT JET IN DENSITY-STRATIFIED WATER,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
R. Gu, and H. G. Stefan.
Journal of Environmental Engineering (ASCE) JOEDDU, Vol. 114, No. 4, p 878-897, August 1988. 11 fig, 21 ref.

Descriptors: *Hydraulics, *Jets, *Outfall, *Turbulent flow, *Density stratification, Entrainment, Model studies, Temperature gradient, Velocity distribution, Pressure distribution, Mixing, Buoyancy.

By applying the similarity hypothesis for velocity and temperature profiles and deriving an entrainment function from the integral equations, a general model was developed for a jet in a stratified ambient fluid. The integral approach was used and extended. The model predicted jet trajectories, centerline temperature or density and velocity decay, and dilution on the axis of a turbulent buoyant jet discharged at an arbitrary angle into a density-stratified or uniform ambient. The pressure distribution was not hydrostatic as in most other models. The effects of density change and jet curvature on pressure were explicitly evaluated. Predictions obtained with the model are compared with experimental measuremetns of the centerline trajectory for several round buoyant jets discharged at various angles into stably stratified ambients. The quality of prediction was quite good for these flows. (See also W89-00492) (Shidler-PTT)
W89-00491

GEOSTATISTICS APPLIED TO GROUNDWATER POLLUTION: III. GLOBAL ESTIMATES,
Oregon State Univ., Corvallis. Dept. of Agricultural Engineering.
J. D. Istok, and R. M. Cooper.
Journal of Environmental Engineering (ASCE) JOEDDU, Vol. 114, No. 4, p 915-928, August 1988. 2 fig, 1 tab, 7 ref.

Descriptors: *Path of pollutants, *Groundwater pollution, *Statistical methods, *Kriging, *Estimating, Plumes, Theoretical analysis, Numerical analysis, Error analysis, Waste dumps.

Kriging, a geostatistical technique, can be used to obtain the best (minimum estimation error) linear, unbiased estimates of contaminant concentrations at points within a contaminant plume from a set of measured contaminant concentrations. The theoretical and numerical procedures needed to combine these local estimates to obtain global estimates for the mean contaminant concentration in any specified portion of the plume. Procedures for computing global estimation errors are also given. Global estimates and estimation errors can then be used to compute standard confidence intervals. The use of the methods is illustrated by a set of measured groundwater contaminant concentrations from a hazardous waste site. (Author's abstract)
W89-00493

CONTAMINANT PROPAGATION IN DISTRIBUTION SYSTEMS,
Environmental Protection Agency, Cincinnati, OH. Office of Research and Development.
For primary bibliographic entry see Field 5F.
W89-00494

MOTOR-BOAT-DERIVED VOLATILE ORGANIC COMPOUNDS (VOC) IN LAKE WATER,
Tuebingen Univ. (Germany, F.R.). Inst. fuer Chemische Pflanzenphysiologie.
F. Juettner.
Zeitschrift fuer Wasser und Abwasser-Forschung ZWABAQ, Vol. 21, No. 2, p 36-39, April 1988. 1 fig, 2 tab, 9 ref.

Descriptors: *Boats, *Water pollution sources, *Lakes, *Navigation canals, *Volatile organic compounds, Pollutants, Benzenes, Methylindane, Methylindenes, Styrenes, Aliphatic hydrocarbons, Boats, Lake Constance, Pollutant identification.

In a canal to the harbor of a fresh water lake (Lake Constance), the input of organic emission products of motor boats into the water was qualitatively and quantitatively analyzed. Aromatic compounds with various substituents were the major volatile substances introduced. Dialkylbenzenes substituted in the meta-position and asymmetrically trisubstituted benzenes were favored. In addition, several substituted styrenes, unsaturated C3- and C4-benzenes, methylindanes and methylindenes were observed. Aliphatic hydrocarbons were of less importance. A dramatic increase in all of these substances was noticed when only a few boats passed through the canal. (Author's abstract)
W89-00499

FREQUENT AND IMPORTANT CONSEQUENCES FROM INCREASED AMOUNTS OF LIQUID MANURE (HAEUFIGE UND WICHTIGE FOLGEN VERMEHRTEN GUELLEANFALLS),
Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.).
I. Ritzl, and D. Reiml.
Zeitschrift fuer Wasser und Abwasser-Forschung ZWABAQ, Vol. 21, No. 2, p 40-44, April 1988. 4 fig, 1 tab, 21 ref.

Descriptors: *Manure, *Path of pollutants, *Environmental effects, *Nitrogen, Copper, Nitrate, Eutrophication, Soil, Atmosphere, Surface water, Groundwater.

Disposal of increasing amounts of liquid manure result in a series of environmental problems. This short study reviews frequent and important consequences. The problem is characterized by the regu-

latory situation and the irregular distribution of liquid manure. Liquid manure constitutes a source of nitrogen and therefore influences the nitrogen balance in surface waters, groundwater, soil and in air. Imbalances often provoke eutrophication but also can lead to the release of dangerous trace gases into the atmosphere. The following problematic areas are discussed as well: input of nitrate into groundwater, input of copper into soil, proper storage of liquid manure and use of inhibitors of nitrification. (Author's abstract)
W89-00500

INFLUENCE OF SELECTED ORGANIC COMPLEXING AGENTS ON THE SORPTION OF HEAVY METALS IN RIVER SEDIMENTS (EINFLUSS AUSGEWAEHLTER ORGANISCHER KOMPLEXBILDNER AUF DIE SORPTION VON SCHWERMETALLEN AN GEWAESSERSEDIMENTE),
Technische Univ. Hamburg-Harburg (Germany, F.R.). Arbeitsbereich Umweltschutztechnik.
F. Dehnad, and U. Foerstner.
Zeitschrift fuer Wasser und Abwasser-Forschung ZWABAQ, Vol. 21, No. 2, p 46-50, April 1988. 5 fig, 2 tab, 10 ref.

Descriptors: *Rivers, *Sediments, *Heavy metals, *Path of pollutants, *Chelating agents, Glycine, Citric acid, Humic acids, Nitrilotriacetic acid, Ethylenediaminetetraacetic acid, Nickel, Cadmium, Copper, Pollutants.

The effect of complexation of five chelating agents (glycine, citric acid, humic acid, nitrilotriacetic acid and ethylenediaminetetraacetic acid) on the sorption of selected heavy metals (Ni, Cd and Cu) onto river sediment was investigated. The sediment used was sludge from Hamburg Harbour from which heavy metals had been extracted by ethylenediaminetetraacetic acid. The results of these experiments show that nitrilotriacetic acid and ethylenediaminetetraacetic acid cause a distinct decrease of heavy mental sorption on model sediment. Glycine, citric acid and humic acid were not effective in altering heavy metal/sediment interactions at relevant river water concentrations. (Author's abstract)
W89-00501

LOAD ALLOCATION FOR TOXICS USING MONTE CARLO TECHNIQUES,
For primary bibliographic entry see Field 5G.
W89-00514

EFFECTS OF DISCONTINUING DISINFECTION ON A RECEIVING WATER,
Illinois Inst. of Tech., Chicago. Dept. of Environmental Engineering.
For primary bibliographic entry see Field 5D.
W89-00515

HYDROLOGICAL FEATURES OF POYANG LAKE (II), (IN CHINESE),
Hydrometerological Experiment Station of Poyang Lake, Xingzi (China).
For primary bibliographic entry see Field 2H.
W89-00535

CHROMIUM SPECIATION IN THE HUANGHE RIVER AND ITS ESTUARINE REGION, (IN CHINESE),
Academia Sinica, Qingdao (China). Inst. of Oceanology.
H. Huarui, and P. Xuezhong.
Oceanologia et Limnologia Sinica OECOBX, Vol. 18, No. 6, p 596-605, November 1987. 6 fig, 2 tab, 13 ref.

Descriptors: *Path of pollutants, *Estuaries, *Rivers, *Chromium, *Heavy metals, *Trace metals, Chemical properties, Sediments, Seasonal variation, Huanghe River, China.

At the start of the dry season, the average content of total chromium, total dissolved chromium, trivalent chromium, hexavalent chromium, and particulate chromium in the lower reaches of the Huanghe River are 25.55, 1.04, 0.781. 0.169 and 24.43 micrograms/L, respectively. Those in the estuarine region are 2.39, 0.443, 0.438, 0.005 and 1.95 micrograms/L, respectively. At the start of the wet season, the average content of total chromium, total dissolved chromium, trivalent chromium, hexavalent chromium and particulate chromium in the lower reaches of the Huanghe River are 484, 1.23, 0.965, 0.268 and 483 micrograms/L, respectively. Those in the estuarine region were 6.26, 0.703, 0.621, 0.082 and 5.56 micrograms/L, respectively. Contents of different species of chromium in the wet season are higher than in the dry season. At the start of the dry season, the average ratio of particulate chromium, trivalent chromium, and hexavalent chromium to total chromium in river water of the Huanghe River are 95.61%, 3.80% and 0.59%. Those in the sea water of the estuarine area are 77.76%, 21.96% and 0.28%, respectively. At the start of the wet season, the average ratios in river water are 99.74%, 0.20% and 0.6%, respectively, while those in sea water are 47.09%, 45.89% and 7.02%, respectively. Particulate chromium is the principal species in the river water; trivalent chromium is next; the last is hexavalent chromium. The speciation is similar in the adjacent estuary and river water, but trivalent chromium in far off estuarine areas is the predominant species in the wet season, and hexavalent chromium is a secondary speciation. When violent physical and chemical changes occur in the Huanghe estuary, large amounts of organic matter in the water may reduce hexavalent chromium to trivalent chromium, which is then readily adsorbed or complexed by suspended matter, and forms particulate chromium, which coagulates and settles in the sediments, completing the transference processes of particulate chromium to the estuarine sediment. (Author's abstract)
W89-00544

TRANSIENT LIVER PATHOLOGY IN PATIENTS CONSUMING WATER FROM A PRIVATE WELL CONTAMINATED BY PCBS FROM A SUBMERSIBLE WATER PUMP,
State Univ. of New York Upstate Medical Center, Syracuse.
For primary bibliographic entry see Field 5C.
W89-00558

ESTIMATE OF THE VARIABILITY IN BIOTRANSFORMATION KINETICS OF XENOBIOTICS IN NATURAL WATERS BY AUFWUCHS COMMUNITIES,
Environmental Research Lab., Athens, GA.
H. P. Kollig, R. S. Parrish, and H. W. Holm.
Chemosphere CMSHAF, Vol. 16, No. 1, p 49-60, 1987. 1 fig, 8 tab, 4 ref.

Descriptors: *Fate of pollutants, *Biodegradation, *Pesticides, *Herbicides, *Cresols, Aufwuchs, Biomass, 2,4-D, Degradation, Model studies, Rivers, Ponds, Kinetics.

An experiment was conducted to investigate the variability in biotransformation kinetics of xenobiotics in natural waters by aufwuchs communities. Two chemicals were used: 2,4-dichlorophenoxyacetic acid butoxyethyl ester (2,4-DBE) and para-cresol. Teflon strips were colonized at two sites each in two ponds and two rivers. The colonized strips and the natural waters were transported to the laboratory where the biotransformation rate studies were done in duplicate under controlled conditions. Analysis of variance at the 0.10 level of significance revealed a significant difference in biotransformation rate coefficients between ponds and between sites within one pond for both xenobiotics, and between rivers for para-cresol only. No significant difference was found between sites within rivers for either xenobiotic, nor was any significant difference found between rivers for 2,4-DBE. Differences in biotransformation rates were less variable and more detectable in quiescent waters than in faster flowing waters. (Author's abstract)
W89-00559

SEDIMENT-WATER PARTITION COEFFICIENTS AND HPLC RETENTION FACTORS OF AROMATIC HYDROCARBONS,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
P. D. Vowles, and R. F. C. Mantoura.
Chemosphere CMSHAF, Vol. 16, No. 1, p 109-116, 1987. 4 fig, 1 tab, 23 ref.

Descriptors: *Path of pollutants, *Aromatic compounds, *Hydrocarbons, *Chromatography, *Sediment-water interface, Partition coefficients, Organic compounds, Solubility, Benzene, Xylene, Naphthalene, Phenanthrene, Pyrene, Methylbenzene, Ethylbenzene, Propylbenzene, Butylbenzene, Methylnaphthalene, Ethylnaphthalene.

Sediment-to-water partition coefficients were measured for fourteen alkylbenzene and polyaromatic hydrocarbons together with their HPLC capacity factors. The partition coefficients varied between 10 to the 0.2 power and 10 to the 3.7 power, and different homologous series of hydrocarbons separately correlated both the octanol-water partition coefficients and octadecylsilane capacity factors. All partition coefficients correlated well with the alkylcyano capacity factors, possibly because this mildly polar phase mimics better the sorption onto sediment than either octanol or octadecylsilane phases. (Author's abstract)
W89-00560

LIGNIN RESIDUES AS TRACERS OF ORGANIC WASTE TRANSPORT,
Gulf Coast Research Lab., Ocean Springs, MS.
For primary bibliographic entry see Field 7B.
W89-00561

SOURCES OF WATERCOURSE POLLUTION IN ITALY AND MEDITERRANEAN FRANCE, ASSESSED BY MACROPHYTES,
S. M. Haslam.
Chemosphere CMSHAF, Vol. 16, Nos. 2/3, p 331-337, 1987. 1 fig, 6 ref.

Descriptors: *Water pollution sources, *Water quality control, *Italy, *France, *Aquatic plants, Macrophytes, Vegetation, Alpine regions, Effluents, Nonpoint pollution sources, Fertilizers, Agriculture, Acidic water, Herbicides, Organic matter, Turbidity, Pesticides, Rivers, Streams.

Macrophytes in streams and rivers may be plentiful, sparse, or absent, depending on natural conditions and man's activities. Natural factors which reduce watercourse vegetation are high water force in mountains, unstable flows and substrates, summer drought, shading, overly deep water, and grazing by aquatic animals. The principal man-made factors reducing vegetation are drainage (including streams lost or directed through pipes), pollution, channel straightening, channelization, vegetation management (dredging, cutting, herbicides), depth and flow alterations, navigation, planting of shading trees and hedges. The lowlands of southwest France are severely polluted from agricultural activities. In the Po plain around Milan industrial pollution has seriously reduced stream vegetation. On the flatter Italian coasts and in much of Sicily villages and cities contribute domestic wastes to the streams, and gravel extraction and quarrying produce turbidity and unstable substrates. Some suggestions for decreasing pollution in this area are as follows: improved sewage treatment facilities, control of biocide and fertilizer use, use of aquatic vegetation to remove organic and toxic material, and buffer strips on uncultivated land on each side of a watercourse. (Cassar-PTT)
W89-00563

ECOLOGICAL PARAMETER OF SURFACE WATER IN NORTHEASTERN GREECE,
Demokritos Univ. of Thrace, Komotini (Greece).
K. Ouzounis, and N. Sotiriou.
Chemosphere CMSHAF, Vol. 16, Nos. 2/3, p 351-359, 1987. 3 fig, 2 tab, 6 ref.

Descriptors: *Water pollution effects, *Greece, *Water pollution sources, *Lakes, *Rivers, *Chlorinated hydrocarbons, Nutrients, Pesticides, Nitrates, Phosphates, Dissolved oxygen, Oxygen,

Lake Vistonis, Kosynthos River, Industrial wastes, Fish, Water quality.

Water quality was studied in Lake Vistonis and the River Kosynthos in northeastern Greece. The largely agricultural region uses large amounts of fertilizers and pesticides. The few industries release untreated wastes into the river. Total fish production (carps and eels) has declined notably from 1963 to 1983. Maximum production was in 1968-70; minimum production, in 1975 and 1983. Dissolved oxygen in a polluted reach of the river measured in September 1984 varied from about 5 ppm at midday to nearly zero at night. Dissolved oxygen in the lake surface waters increased to the saturation point in summer, but in the depths it declined to less than 4-5 mg/liter. Water quality parameters for the river and lake, respectively, were as follows: pH, 7 and 9.5-10; ammonium-N, 1.8 and 1.5-3.5 mg/liter; nitrate-N, 1.5 mg/liter and none detected; and phosphate-P, 1.3 and 0.2 mg/liter. Chlorinated hydrocarbons and pesticides levels were generally low. (Cassar-PTT)
W89-00564

ENVIRONMENTAL CONDITIONS IN ABU KIR BAY, EAST OF ALEXANDRIA: I. PHYSICO-CHEMICAL CHARACTERISTICS AND WATER CIRCULATION,
Alexandria Univ. (Egypt). Dept. of Oceanography.
M. M. Osman, and M. M. Dorgham.
Chemosphere CMSHAF, Vol. 16, Nos. 2/3, p 361-368, 1987. 10 fig, 8 ref. UNESCI/UNDP/Alexandria University Project EGY/73/058.

Descriptors: *Water pollution sources, *Path of pollutants, *Estuaries, *Egypt, *Bays, *Water quality, *Water circulation, Abu Kir Bay, Alexandria, Nitrates, Thermal pollution, Phosphates, Nile River, Agricultural runoff, Fish, Salinity, Nutrients, Outfalls, Wastewater disposal.

The water quality and circulation of Abu Kir Bay was studied in November 1983. This shallow basin receives pollution from the Tabia pumping station outfall (industrial wastewater mixed with agricultural and domestic wastewater), the Maadyia lake-sea outlet (mostly agricultural drainage water), and the Rosetta mouth of the Nile River. Other pollution in the bay is derived from powerplant cooling water and offshore oil and gas fields. Surface water characteristics showed three distinguishable zones corresponding to the three main effluent outfalls. Compared with unimpacted bay waters, the surface water in the three zones had lower salinity, slightly lower temperature (except for the powerplant thermal pollution), higher ammonia levels (maximum 48 microgram/liter), higher nitrate levels (up to 6.09 microgram/liter), higher phosphate levels (up to 6.50 microgram/liter), lower nitrate/phosphorus ratios (<3), depleted silicate levels, and higher suspended matter (85 mg/liter near the Tabia outfall). The surface water circulation is characterized by a counterclockwise eddy occupying the southwest and central parts of the bay and a clockwise eddy covering the northeast part. This circulation regime restricts water exchange between the inshore and offshore regions of the bay. Here, the recently constructed breakwater further reduces the water exchange. (See also W89-00578) (Cassar-PTT)
W89-00565

CORRELATION OF SOME ORGANIC POLLUTION FACTORS IN WATER SYSTEMS IN NORTHERN GREECE,
Thessaloniki Univ., Salonika (Greece). Lab. of Analytical Chemistry.
A. Voulgaropoulos, K. K. Fytianos, A. Apostolopoulou, and X. Gounaridou.
Chemosphere CMSHAF, Vol. 16, Nos. 2/3, p 395-398, 1987. 2 fig, 1 tab, 4 ref.

Descriptors: *Water pollution sources, *Path of pollutants, *Rivers, *Greece, *Lakes, Water quality, Axios River, Loudias River, Agios Vasilios Lake, Organic matter, Agricultural runoff, Dissolved oxygen, Domestic wastes, Food-processing wastes, Dye industry wastes.

Organic pollution was studied in two rivers and a lake in northern Greece during 1984-1985. Parameters measured included total organic carbon, dissolved oxygen, fluorescence, absorbance, complexing capacity, temperature, conductance, hardness, alkalinity, and total iron content. Lake Agios Vasilios was most heavily polluted with organic matter. Loudias River was more heavily polluted than Axios River. Sources of the pollutants were domestic and agricultural effluents and industrial wastes from food processing and dyehouses. In spite of the dense population and heavy industrialization along the Axios River, its water quality is better than the Loudias River because of differences in mean water discharges: 170 cu m/sec for Axios and 40 cu m/sec for Loudias. (Cassar-PTT)
W89-00566

LONG TERM IMPACT OF DISSOLVED DISPERSED PETROLEUM HYDROCARBONS (DDPH) IN GULF OF ISKENDERUN,
Middle East Technical Univ., Ankara (Turkey). Inst. of Marine Sciences.
I. Salihoglu, C. Saydam, and A. Yilmaz.
Chemosphere CMSHAF, Vol. 16, Nos. 2/3, p 381-394, 1987. 6 fig, 4 tab, 8 ref.

Descriptors: *Path of pollutants, *Oil spills, *Gulf of Iskenderun, *Mediterranean Sea, Marine sediments, Sediments, Fish, Marine animals, Organic compounds, Aromatic compounds, Gulfs, Seasonal variation.

Petroleum hydrocarbons and polyaromatic hydrocarbons were monitored in sediment and marine biota from August 1981 to April 1984 in the Gulf of Iskenderun. About 8,000 tons of crude oil entered the gulf in April 1982 via the Ceyhan River from a pipeline crack. Petroleum hydrocarbon levels were maximum in winter (about 4 mg/liter C in April 1982 and about 2 mg/liter C in April 1983) and minimum in summer (about 0.5 mg/liter C in late summers of 1982 and 1983), an inverse relationship with the seawater temperature. Concentrations of polyaromatic hydrocarbons in fish liver and flesh were generally higher in the summer after the oil leak. However, high values were also reported for some species in March 1982. Polyaromatic hydrocarbon levels in sediments started to increase in April 1982 and reached a maximum two months later. (Cassar-PTT)
W89-00567

BORON LEVELS IN SOME GROUND WATERS OF HALKIDIKI (A LAND AT NORTHERN AEGEAN SEA),
Thessaloniki Univ., Salonika (Greece). Dept. of Civil Engineering.
E. Papachristou, R. Tsitouridou, and B. Kabasakalis.
Chemosphere CMSHAF, Vol. 16, Nos. 2/3, p 419-427, 1987. 4 fig, 1 tab, 17 ref.

Descriptors: *Geochemistry, *Water pollution sources, *Groundwater pollution, *Boron, Halkidiki, Greece, Irrigation water.

Boron contents (in ppm) of natural waters in the Halkidiki, Greece, region were as follows: artesian water of Eleochoria, 5.240; Giannakara well water, 5.400; Petralona well water, 2.330; and Agia Paraskevi thermal spring, 43.210. None of these waters are suitable for irrigating the most sensitive crops, fruit trees. The Petralona water is of borderline quality for irrigating potatoes, tomatoes, peas, wheat and oats, which can tolerate 1-2 mg/liter boron. The Giannakara well water and Eleochoria artesian waters are too boron-rich to grow the least sensitive plants, sugar beet, onions, cabbage, and carrots. (Cassar-PTT)
W89-00569

TWO TOXICANTS, MERCURY AND TIN IN THE GULF OF ISKENDERUN,
Middle East Technical Univ., Ankara (Turkey). Inst. of Marine Sciences.
I. Salihoglu, C. Saydam, and S. Yemenicioglu.
Chemosphere CMSHAF, Vol. 16, Nos. 2/3, p 445-453, 1987. 1 fig, 5 tab, 11 ref.

Descriptors: *Water pollution sources, *Path of pollutants, *Bioaccumulation, *Heavy metals, *Gulf of Iskenderun, *Turkey, Metals, Mercury, Tin, Sediments, Fish, Mediterranean Sea, Marine sediments, Marine animals, Bays, Estuaries.

Mercury and tin concentrations were determined in effluents, rivers, seawater, fish, and sediments of the Gulf of Iskenderun. In effluents total mercury levels were up to 261 ng/liter; in rivers, 17-38 ng/liter. Inorganic tin levels were highest in the Isdemir iron and steel complex effluent, 1115 ng/liter. Average total mercury concentration is seawater was 9.5 ng/liter, most associated with suspended sediment. Average inorganic tin concentrations in the bay were 319 ng/liter, about 10 times the concentrations in other sections of the study area. Sources of tin in the bay are industrial waste and shipping activities. Mercury and tin levels in fish increased with age of the fish. Highest recorded levels were 485 ng Hg/g wet weight in the oldest Upeneus moluccensis from Ceyan River Estuary and 324 ng Sn/g wet weight in the same species from Iskenderun Bay. Fish species differed in their ability to concentrate tin and mercury. In sediments, the highest mercury concentrations were found in the Mersin region; the highest tin concentrations were found in Iskenderun Bay. Concentrations of both metals in sediments decreased with distance from the shore. (Cassar-PTT)
W89-00570

COMPARATIVE STUDY OF HEAVY METALS POLLUTION IN VARIOUS RIVERS AND LAKES OF NORTHERN GREECE,
Thessaloniki Univ., Salonika (Greece). Environmental Pollution Control Lab.
K. Fytianos, V. Samanidou, and T. Agelidis.
Chemosphere CMSHAF, Vol. 16, Nos. 2/3, p 455-462, 1987. 1 tab, 8 ref.

Descriptors: *Path of pollutants, *Lakes, *Rivers, *Heavy metals, *Greece, Metals, Axios River, Loudias River, Aliakmon River, Nestos River, Strymon River, Kastoria Lake, Agios Vasilios Lake, Vistonis Lake, Vegoritis Lake, Doirani Lake, Mercury, Lead, Cadmium, Copper, Zinc, Iron, Chromium.

Rivers and lakes in northeastern Greece were analyzed for heavy metals content over a one year period. The heavy metal concentrations were correlated to the pollution sources. A direct dependence of the suspended heavy metals on the rivers' discharges could be only partially determined. The most polluted river was Axios; the least, Nestos. The most polluted lake was Vistonis; the least, Doirani. (Cassar-PTT)
W89-00571

HEAVY METAL POLLUTION IN THE GUADIAMAR RIVER AND THE GUADALQUIVIR ESTUARY (SOUTH WEST SPAIN),
Centro de Edafologia y Biologia Aplicada del Cuarto, Seville (Spain).
F. Cabrera, M. Soldevilla, R. Cordon, and P. de Arambarri.
Chemosphere CMSHAF, Vol. 16, Nos. 2/3, p 463-468, 1987. 6 tab, 14 ref.

Descriptors: *Path of pollutants, *Mine wastes, *Spain, *Heavy metals, *Industrial wastes, Metals, Guadiamar River, Guadalquivir Estuary, Iron, Copper, Manganese, Lead, Zinc, Aquatic plants, Rivers, Estuaries.

Heavy metals data from water, sediment, flora, and fauna of the Guadiamar River and the Guadalquivir Estuary during 1979-1984 are summarized. In the Guadiamar, sampling stations downstream from a polymetallic sulfide mine showed heavy concentrations of heavy metals (Fe, Cu, Mn, Pb, and Zn) compared with unimpacted sampling stations. Heavy metal concentrations decreased downstream due to precipitation as hydrous oxides. During wet seasons heavy metal concentrations were higher because of resuspension of sediments and the presence of olive oil effluents, which contain chelating organic matter. Monitoring during a severe drought when acidifying thiosalts were used in the mine processing showed even higher metals concentrations. This was a result of

decreased precipitation of the metallic hydroxides. Metals levels in soils and sediments did not change regularly with distance to the mine. This was related to drastically irregular flows. Analysis of three river bank plant species showed higher metals levels than background levels at stations downstream of the mine. Metals levels were also reported for Crassotrea angulata, Dicentrarchus labrax, and Mugil auratus in the Guadalquivir Estuary. (Cassar-PTT)
W89-00573

FORMATION OF OXYGEN SPECIES AND THEIR REACTIONS WITH ORGANIC CHEMICALS IN AQUEOUS SOLUTION,
Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Oekologische Chemie.
D. Kotzias, K. Hustert, and A. Weiser.
Chemosphere CMSHAF, Vol. 16, Nos. 2/3, p 505-511, 1987. 4 fig, 2 tab, 6 ref.

Descriptors: *Fate of pollutants, *Humic acids, *Fulvic acids, *Organic matter, *Oxygen, Nitrates, Dissolved oxygen, Photoactivation, Oxidation, Benzene, Cumene, Ultraviolet light.

Factors affecting the photoinduced formation of oxygen species and their reaction with organic chemicals in aqueous solutions were examined. Humic and fulvic acids of different origins reacted at different rates with cumene and benzene. Different molecular weight fractions of the humic and fulvic materials exhibited varying levels of photochemical potential. Increasing nitrate concentrations were correlated with increased photochemical activity toward benzene and cumene and increased production of oxidizing species by the humic materials. (Cassar-PTT)
W89-00575

BACTERIOLOGICAL CONTAMINATION OF THE EASTERN PART OF THE GULF OF TRIESTE (NORTH ADRIATIC) DUE TO SEWAGE DISCHARGE,
Ljubljana Univ. (Yugoslavia). Biological Inst.
V. Turk.
Chemosphere CMSHAF, Vol. 16, Nos. 2/3, p 551-558, 1987. 2 fig, 1 tab, 3 ref.

Descriptors: *Path of pollutants, *Water pollution sources, *Estuaries, *Bacteria, *Gulf of Trieste, Adriatic Sea, Enteric bacteria, Sewage bacteria, Effluents, Coastal waters, Swimming, Coliforms, Wastewater disposal, Beaches, Outfalls.

The dispersion of fecal coliforms in the surface coastal waters of the eastern part of the Gulf of Trieste was studied during 1980-1984. Although most of the sampling stations in recreational areas gave bacteriologic values which were within sanitary quality criteria, some stations had fecal coliforms higher than 1000/100 ml as a result of local and temporary influence from the smaller sewage outfalls. The inner part of the Bay of Koper was the most polluted area, with a maximum of 411,000 fecal coliforms per 100 ml. The large sewage outfalls from the towns of Koper, Izola, and Piran affected water quality for about 400-800 miles from the pollution source. Under most conditions of winds, currents, and tides the polluted water was conducted straight toward the middle of the bay. Occasionally the contaminated water spread towards the shore. (Cassar-PTT)
W89-00577

ENVIRONMENTAL CONDITIONS IN ABU KIR BAY, EAST OF ALEXANDRIA: II. PLANKTON DISTRIBUTION, DOWNSTREAM FROM LAND-BASED EFFLUENTS,
Alexandria Univ. (Egypt). Dept. of Oceanography.
For primary bibliographic entry see Field 5C.
W89-00578

ASSOCIATION BETWEEN SEAWATER POLLUTION AS MEASURED BY BACTERIAL INDICATORS AND MORBIDITY AMONG BATHERS AT MEDITERRANEAN BATHING BEACHES OF ISRAEL,
Hebrew Univ. of Jerusalem (Israel). School of Public Health.
For primary bibliographic entry see Field 5C.
W89-00579

COORDINATED PROGRAMME FOR RESEARCH AND MONITORING OF POLLUTION IN THE MEDITERRANEAN,
United Nations Environment Programme, Athens (Greece). Co-ordinating Unit for the Mediterranean Action Plan.
For primary bibliographic entry see Field 5A.
W89-00582

BIOAVAILABILITY OF POLYCHLORINATED DIBENZO-P-DIOXINS AND DIBENZOFURANS FROM CONTAMINATED WISCONSIN RIVER SEDIMENT TO CARP,
Environmental Research Lab.-Duluth, MN.
D. W. Kuehl, P. M. Cook, A. R. Batterman, D. Lothenbach, and B. D. Butterworth.
Chemosphere CMSHAF, Vol. 16, No. 4, p 667-679, 1987. 1 fig, 6 tab, 4 ref.

Descriptors: *Fate of pollutants, *Path of pollutants, *Fish, *Bioaccumulation, *Carp, *Dioxins, Dibenzofurans, Wisconsin River, Polychlorinated dibenzo-p-dioxin, Accumulation, Rivers, Sediments.

The bioavailability of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) from sediment to fresh water fish was studied in laboratory exposures. Carp (10 g) exposed to Wisconsin River sediment (39 pg/g) for 55 days accumulated 7.5 pg/g. Maintaining exposed fish in clean water for an additional 205 days resulted in depuration of 32-34% TCDD. These values compare to field data where sediments ranged from 30 to 200 pg/g and 1.5 kg carp (70 pg/g) depurated 55% in 325 days. Analysis of sediment, laboratory exposed fish, and Wisconsin River fish for other polychlorinated dibenzo-p-dioxins and dibenzofurans showed residues of 2,3,7 and 8-substitued congeners selectively enriched. (Author's abstract)
W89-00583

SEDIMENTATION OF 74 PCB CONGENERS IN THE UPPER HUDSON RIVER,
New York State Dept. of Health, Albany. Wadsworth Center for Labs. and Research.
B. Bush, L. A. Shane, M. Wahlen, and M. P. Brown.
Chemosphere CMSHAF, Vol. 16, No. 4, p 733-744, 1987. 6 fig, 3 tab, 36 ref.

Descriptors: *Path of pollutants, *Chlorinated hydrocarbons, *Aromatic compounds, *Hudson River, *Polychlorinated biphenyls, Aquatic vegetation, Rivers, Sediments, Dredging, Tidal flats.

Seventy-four congeners of polychlorinated biphenyls (PCBs) were determined in sediment cores from the Hudson River. Some general conclusions were formulated from these analyses. (1) The evaporation of PCB from exposed tidal mud may have an important effect on the composition of PCB found in the estuary. (2) The residue pattern found in an actively collecting sediment pocket, or hot spot, may be the result of precipitation and scavenging from the water column, and not necessarily be the result of anaerobic microbial dechlorination. Dredging of bottom sediment should not be done in these active areas, but in areas with a normal Aroclor 1242 pattern. (Cassar-PTT)
W89-00584

SORPTION OF HYDROPHOBIC CHEMICALS FROM WATER: A HYPOTHESIS FOR THE MECHANISM OF THE PARTICLE CONCENTRATION EFFECT,
Toronto Univ. (Ontario). Dept. of Chemical Engineering and Applied Chemistry.
D. Mackay, and B. Powers.
Chemosphere CMSHAF, Vol. 16, No. 4, p 745-757, 1987. 3 fig, 17 ref.

Descriptors: *Path of pollutants, *Sorption, *Organic compounds, *Mass transfer, Particle concentration effect, Partition coefficient, Model studies.

A novel conceptual model of the sorption process is consistent with DiToro's particle-induced desorption hypothesis and yields predictions which agree with experimental observations. In this model the sorption process is viewed as being a loose surface accumulation which can be disrupted by collisions between particles. A mass transfer analysis predicts that when a significant fraction (e.g., half) of the sorbate is sorbed, collision-induced desorption becomes important and limits the sorbed concentrations to approximately an equal amount to that in solution. This constraint applies regardless of the nature of the particles and the sorbate. This implies that hydrophobic organic chemicals in an aquatic system are not likely to be sorbed from the water column. Volatilization, bioavailability, and sediment deposition are not considered. (Cassar-PTT)
W89-00585

FORMATION OF 1-NITROPYRENE BY PHOTOLYSIS OF PYRENE IN WATER CONTAINING NITRITE ION,
Science Univ. of Tokyo (Japan). Faculty of Pharmaceutical Sciences.
J. Suzuki, T. Hagino, and S. Suzuki.
Chemosphere CMSHAF, Vol. 16, No. 4, p 859-867, 1987. 6 fig, 2 tab, 25 ref.

Descriptors: *Water pollution sources, *Path of pollutants, *Aromatic compounds, *Pyrene, Mutagens, Photolysis, Chemical reactions, Nitrites, Degradation.

An ether extract from pyrene suspended in water containing nitrite ion was irradiated with a high-pressure mercury lamp. The product showed strong mutagenicity toward S. typhimurium TA98 in the absence of S9. The mutagenicity of the ether extract increased with increasing nitrite concentration and irradiation time and with lowering in pH of the solution. The major mutagen was identified as 1-nitropyrene. A pyrequinone was also tentatively identified. (Cassar-PTT)
W89-00586

SURVEY OF MERCURY, LEAD AND CADMIUM IN MUSCLE OF BRITISH FRESHWATER FISH,
Essex Univ., Colchester (England). Dept. of Biology.
C. F. Mason.
Chemosphere CMSHAF, Vol. 16, No. 4, p 901-906, 1987. 1 fig, 2 tab, 9 ref.

Descriptors: *Path of pollutants, *Fish, *Heavy metals, *Bioaccumulation, Metals, Mercury, Lead, Cadmium, Eel, Roach, Great Britain.

Heavy metals were determined in muscle of 221 fish, mainly eel and roach, from 67 sites in Great Britain. The region was divided into five regions: Southwest England, Wales, East Anglia, Northeast England, and Northeast Scotland. Average mercury concentrations (microgram/kg fresh weight) in eel for these regions, respectively, were 128, 178, 309, no sample, and 362. Average lead concentrations (microgram/kg fresh weight) in eel were, in the same order, 440, 920, too-small sample, no sample, and 2060. Average cadmium concentrations (microgram/kg fresh weight) in eel were, in the same order, 70, 220, below limit of detection, no sample, and 690. Average mercury concentrations (microgram/kg fresh weight) in roach for these regions, respectively, were 66, 72, 53, 67, and no sample. Average lead concentrations (microgram/kg fresh weight) in roach were, in the same order, 1570, 320, 1110, 890, and no sample. Average cadmium concentrations (microgram/kg fresh weight) in roach were, in the same order, 120, 100, 90, 50, and no sample. Compared with the standard of a maximum of 300 microgram/kg mercury in fish flesh for consumption, 25% of eels sampled contained excessive mercury. The 2000 microgram/kg lead standard was exceeded in 16.7% of eels and 25.3% of roach. If 500 microgram/kg of cadmium is used as an unofficial standard, 23.3% of eels and 6.7% of roach would be inedible. (Cassar-PTT)
W89-00587

EFFECTS OF HIGH LEVELS OF POLYCYCLIC AROMATIC HYDROCARBONS ON SEDIMENT PHYSICOCHEMICAL PROPERTIES AND BENTHIC ORGANISMS IN A POLLUTED STREAM,
Virginia Inst. of Marine Science, Gloucester Point. Div. of Chemistry and Toxicology.
For primary bibliographic entry see Field 5C.
W89-00589

LEACHING OF MERCURY FROM PEAT SOIL,
Helsinki Univ. (Finland). Dept. of Environmental Science.
M. Lodenius, A. Seppanen, and S. Autio.
Chemosphere CMSHAF, Vol. 16, No. 6, p 1215-1220, 1987. 4 fig,1 tab, 10 ref.

Descriptors: *Path of pollutants, *Leaching, *Mercury, Metals, Peat, Sorption, Fertilizers, Soil properties, Heavy metals, Lysimeters, Soil water, Decomposing organic matter.

Sorption and leaching of mercury from peat soil were studied using small additions of labeled mercury in peat lysimeters. Additions of chloride, fertilizer or sterilant (sodium azide) did not affect the leaching of mercury. Complete drying of the peat improved the leaching of mercury, probably because of changes in the physical properties of the soil. (Author's abstract)
W89-00592

PHOTOCHEMICAL REACTION OF BIPHENYL IN WATER CONTAINING NITRITE OR NITRATE ION,
Science Univ. of Tokyo (Japan). Faculty of Pharmaceutical Sciences.
J. Suzuki, T. Sato, A. Ito, and S. Suzuki.
Chemosphere CMSHAF, Vol. 16, No. 6, p 1289-1300, 1987. 6 fig, 2 tab, 14 ref.

Descriptors: *Fate of pollutants, *Biphenyl, *Nitrites, *Nitrates, *Photolysis, *Oxidation, Aromatic compounds, Organic compounds, Irradiation, Chemical reactions, Mutagens, Degradation, Light effects.

Photochemical reaction of biphenyl with nitrate and nitrite in aqueous solution was investigated using two light sources, i.e., high-pressure mercury lamps fitted with a quartz glass filter and a Pyrex glass filter. Biphenyl was found to be photochemically hydroxylated and nitrated (producing nitrophenols) in either nitrate or nitrate solutions, and the reaction was suppressed by excluding wavelengths of light shorter than 300 nm (the Pyrex glass filter) in aqueous nitrate solution. In aqueous nitrite solution, however, the reaction proceeded easily even with irradiation from either light source. The same tendency was observed in the formation of mutagens (dihydroxydinitrobiphenyls). (Cassar-PTT)
W89-00593

ANALYSIS OF ATRAZINE IN UNDERGROUND WATERS AT PART PER TRILLION LEVELS AS AN EARLY WARNING METHOD FOR CONTAMINATION AND FOR SOIL DISTRIBUTION STUDIES,
Istituto di Ricerche Farmacologiche Mario Negri, Milan (Italy). Lab. of Environmental Pharmacology and Toxicology.
For primary bibliographic entry see Field 5A.
W89-00596

AGE TO PCB CONCENTRATION RELATIONSHIP WITH THE STRIPED BASS (MORONE SAXATILIS) IN THE HUDSON RIVER AND LONG ISLAND SOUND,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
D. W. Connell.
Chemosphere CMSHAF, Vol. 16, No. 7, p 1469-1474, 1987. 1 fig, 16 ref.

Descriptors: *Path of pollutants, *Chlorinated hydrocarbons, *Fish, *Hudson River, Long Island Sound, *Bioaccumulation, Accumulation, Striped bass, New York, Polychlorinated biphenyls, Model studies.

An increase in polychlorinated biphenyl (PCB) concentration with length was observed in striped bass from the Hudson River and Long Island Sound, New York. Physico-chemical characteristics and concentrations of the chemical were estimated for the water bodies. Using first-order bioconcentration kinetics, this data allowed calculation of fish concentrations at different lengths/ages. The derived data was in reasonable agreement with observed data. This indicated that the observed relationship between length and concentration is due to the slow rate of bioconcentration of the PCBs, particularly the more highly chlorinated congeners. (Author's abstract)
W89-00597

HYDROCARBON FUEL SPILL DISPERSION ON WATER: A LITERATURE REVIEW,
Battelle Columbus Div., OH. Environmental Physics and Chemistry Section.
S. A. Edgerton, R. W. Coutant, and M. V. Henley.
Chemosphere CMSHAF, Vol. 16, No. 7, p 1475-1487, 1987. 60 ref. Air Force Engineering and Services Center Grant F08635-85-C-0122.

Descriptors: *Path of pollutants, *Literature reviews, *Oil spills, *Fate of pollutants, Temperature effects, Light effects, Hydrocarbons, Fuel, Jet fuel, Gasoline, Evaporation, Biodegradation, Degradation, Oxidation, Adsorption, Suspended sediments, Sediments.

A literature review of the fate of light hydrocarbon fuel spills on water focuses on jet fuels. Some discussion is presented on gasoline, diesel, marine, and kerosene fuel spills. The two major fates of light hydrocarbon spills are evaporation and dissolution. Other possible mechanism, which are of less importance, are biodegradation, photooxidation, and adsorption onto suspended sediments. Factors which influence the fate of the hydrocarbons components in the spill include water and air turbulence and temperature, fuel composition, sediment load in the water, past history of biological components in the water, the presence of surface films, and ultraviolet radiation. (Cassar-PTT)
W89-00598

DEGRADATION OF BISPHENOL A IN NATURAL WATERS,
Shell Development Co., Houston, TX.
P. B. Dorn, C.-S. Chou, and J. J. Gentempo.
Chemosphere CMSHAF, Vol. 16, No. 7, p 1501-1507, 1987. 1 fig, 4 tab, 12 ref.

Descriptors: *Fate of pollutants, *Biodegradation, *Bisphenol A, *Aromatic compounds, Oxidation, Hydrocarbons, Houston Ship Channel, Patricks Bayon, Texas.

The environmental degradation of polycarbonate grade Bisphenol A (2,2'-bis (p-hydroxyphenyl propane), CAS 80-05-7) was measured using local waters in the Houston Ship Channel. A spike of 3 mg/liter of Bisphenol A was added to four laboratory units containing fresh water (control), Houston Ship Channel water, Patricks Bayou water (200 yards downstream from a Bisphenol A chemical plant discharge), and in the chemical plant treated process effluent. Greater than 90% degradation was seen in all treatments except the control within four days. The initiation of biodegradation in the units was in the following order: effluent > Patricks Bayou > Houston Ship Channel. Potential points of oxidation in the Bisphenol A molecule are the phenolic moities (forming alkylcatechols) or the methyl groups on the propane moiety (forming alcohol and carboxylic acid derivatives). (Cassar-PTT)
W89-00600

BIOTIC AND ABIOTIC DEGRADATION RATES OF METHYL PARATHION IN FRESHWATER AND ESTUARINE WATER AND SEDIMENT SAMPLES,
Environmental Protection Agency, Gulf Breeze, FL. Gulf Breeze Environmental Research Lab.
P. H. Pritchard, C. R. Cripe, W. W. Walker, J. C. Spain, and A. W. Bourquin.
Chemosphere CMSHAF, Vol. 16, No. 7, p 1509-1520, 1987. 4 fig, 3 tab, 14 ref. U.S. EPA Grant CR-809797 and CR-809370.

Descriptors: *Fate of pollutants, *Parathion, *Degradation, *Pesticides, *Biodegratation, Seasonal variation, Spatial variation, Insecticides, Methyl parathion, Estuaries, Sediments.

Statistical analysis of degradation rates of methyl parathion samples from two Gulf Coast estuaries over a three-year period indicated that biodegradation occurred in the presence of sediment but was insignificant in water. Sediment rates always showed the same relative five-fold difference at a primary site within each estuarine area. Samples from 11 ancillary sites indicated biodegradation rates in sediments can be subdivided into two groupings which were independent of seasonal differences (excluding temperature). Spatial variations in rates, therefore, may be of minor environmental significance for this chemical in estuarine areas. (Author's abstract)
W89-00601

CHARACTERISTICS OF SOIL AFTER POLLUTION WITH WASTE WATERS FROM OLIVE OIL EXTRACTION PLANTS,
Granada Univ. (Spain). Dept. of Microbiology.
For primary bibliographic entry see Field 5C.
W89-00602

LONG-TERM STUDY OF ECOSYSTEM CONTAMINATION WITH 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN,
Office of Science and Technology Policy, Washington, DC.
A. L. Young, L. G. Cockerham, and C. E. Thalken.
Chemosphere CMSHAF, Vol. 16, Nos. 8/9, p 1791-1815, 1987. 12 tab, 25 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Water pollution effects, *Dioxins, *Ecosystems, *Soil contamination, *Pesticides, Herbicides, Agent Orange, Eglin Air Force Base, Florida, Toxicity, Vegetation effects, Wildlife, Mouse, Mammals, Degradation, Photodegradation, Birds, Insects, Fish, Reptiles, Amphibians, Long-term studies.

A review is presented of the final results of a long-term field study of an ecosystem contaminated with 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). The 15-year study focus is on a unique 3.0 sq km military test area (Test Area C-52A, Eglin Air Force Base, Florida) that was aerially sprayed with 73,000 kg 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) and 77,000 kg 2,4-dichlorophenoxyacetic acid (2,4-D) during the period 1962-1970. Data from the analyses of archived herbicide samples and from soil samples collected from 1970 through 1984 suggested that less than 1% of the approximately 2.8 kg TCDD disseminated on the test area persisted in the soil environment. Over the years of observation (1969-1984), approximately 341 species of organisms were observed and identified as associated with the test area. More than 300 biological samples were analyzed for TCDD, and detectable residues were found in 32 different species (mammals, birds, insects, reptiles, amphibians and fish). Examination of the ecological niches of the species positive for TCDD residue suggested that the commonality was a close relationship to contaminated soil. Studies spanning more than 50 generations of the beachmouse, Peromyscus polionotus, concluded that exposure to soil concentrations of TCDD in the range of 0.1 to 1.5 ppb have a minimal effect upon the health and reproduction of this species. (Author's abstract)
W89-00603

MONITORING OF PCDDS IN OSAKA BAY USING BLUE MUSSEL,
Setsunan Univ., Neyagawa (Japan). Faculty of Pharamaceutical Sciences.
H. Miyata, K. Takayama, J. Ogaki, T. Kashimoto, and S. Fukushima.
Chemosphere CMSHAF, Vol. 16, Nos. 8/9, p 1817-1822, 1987. 3 fig, 3 tab, 12 ref.

Descriptors: *Path of pollutants, *Bioindicators, *Dioxins, *Monitoring, *Bioaccumulation, *Japan, Mussels, Blue mussels, Shellfish, Osaka Bay, Hokkaido Bay, Chlorinated hydrocarbons, Polychlorinated biphenyls, Organic compounds, Accumulation.

The pollution of the coastal areas of central (Osaka Bay) and northern (Hokkaido) Japan with polychlorinated dibenzo-p-dioxins (PCDDs) was investigated using blue mussel as a biological indicator. The average levels of PCDDs (in parts per trillion) in the blue mussel from several locations were Hokko (Osaka Bay), 250; Misaki-Cho (Osaka Bay, 160; Funka Bay (Hokkaido), 30; and Rishiri Island (Hokkaido) used as the control, 7.6. The congener profile was distinctly different in each sampling location. Osaka Bay contained a fairly high component ratio of tetra-CDDs, about 50%; ratios at Funka Bay and Rishiri Island were about 30%. Exposure of blue mussels to the chlorinated compounds showed that one month's exposure accumulated 2.8 times the PCDDs and 30 times the polychlorinated biphenyls (PCBs) than the original levels. However, these levels were 1/2 and 1/3, respectively, of the levels found in mussels collected at the same location in the same period. Therefore, more than one month's exposure would be required for the chemicals to accumulate to the maximum levels. (Cassar-PTT)
W89-00604

ROUTINE DETERMINATION OF POLYCHLORINATED BIPHENYL RESIDUES IN FISH AND SHELLFISH IN TAIPEI COUNTY,
Food and Drug Bureau, Taipei (Taiwan).
For primary bibliographic entry see Field 5A.
W89-00605

EMISSIONS OF CHLORINATED ORGANICS FROM A MUNICIPAL SEWAGE SLUDGE BURNING INCINERATOR,
Ontario Ministry of the Environment, Rexdale. Lab. Services Branch.
R. E. Clement, H. M. Tosine, J. Osborne, V. Ozvacic, and G. Wong.
Chemosphere CMSHAF, Vol. 16, Nos. 10-12, p 1895-1900, 1987. 2 fig, 2 tab, 5 ref.

Descriptors: *Air pollution sources, *Sludge disposal, *Path of pollutants, *Chlorinated compounds, *Dioxins, *Incineration, Air pollution, Municipal wastewater, Ontario, Chlorinated dibenzofurans, Municipal wastewater.

Stack emissions of chlorinated dioxins/furans and other chlorinated organics were measured for a municipal sewage sludge burning incinerator. Levels were lower than found in previous studies of municipal refuse incinerators, and were well within established Ontario guidelines. Higher chlorinated dioxins/furans were detected in samples of the raw sludge, while almost no chlorinated organics were detected in the incinerator bottom ash. (Author's abstract)
W89-00607

INVESTIGATION OF THE PRODUCTION OF LIPOPHILIC VOLATILE ORGANOHALOGEN MATERIALS DURING LABORATORY CHLORINATION OF SOME GROUND WATER SAMPLES FROM YUGOSLAVIA,
Institut Rudjer Boskovic, Zagreb (Yugoslavia). Center for Marine Research.
For primary bibliographic entry see Field 5F.
W89-00608

POLYCHLORINATED BIPHENYLS IN THE KUPA RIVER, CROATIA, YUGOSLAVIA,
Sisak Medical Center (Yugoslavia). Dept. of Sanitary Chemistry.
A. Smit, V. Drevenkar, and M. Kodric-Smit.
Chemosphere CMSHAF, Vol. 16, Nos. 10-12, p 2351-2358, 1987. 3 tab, 11 ref.

Descriptors: *Path of pollutants, *Rivers, *Chlorinated hydrocarbons, *Polychlorinated biphenyls, *Kupa River, *Yugoslavia, Organic compounds, Fish, Suspended solids, Sediments.

The presence of polychlorinated biphenyls (PCBs) was investigated in samples of water, suspended particles, sediments and fish from the Kupa River, Croatia, Yugoslavia, along a river stretch extending up to 10 km upstream and 200 km downstream of the primary contaminated karst region. Contamination was due to improper disposal of industrial waste discharge. The PCB levels detected in the samples collected downstream ranged from 1 to 52 ng/liter for water, from 50 to 190 microgram/kg for suspended particles, and from 8 to 39 microgram/kg for the sediment. A wide range of PCB concentrations, from 0.1 to 42.3 microgram/g, which were measured in edible portions of different fish, confirmed a long-term contamination of the river with PCBs. (Author's abstract)
W89-00609

POLYBROMINATED BIPHENYL ETHERS IN MARINE FISH, SHELLFISH, AND RIVER AND MARINE SEDIMENTS IN JAPAN,
Osaka Prefecture Inst. of Public Health (Japan).
I. Watanabe, T. Kashimoto, and R. Tatsukawa.
Chemosphere CMSHAF, Vol. 16, Nos. 10-12, p 2389-2396, 1987. 3 fig, 2 tab, 9 ref.

Descriptors: *Path of pollutants, *Fish, *Shellfish, *Bromine compounds, *Chlorinated hydrocarbons, *Sediments, Marine sediments, Polybrominated biphenyl ethers, Japan, Polychlorinated biphenyls, Hexachlorobenzene, Rivers, Estuaries.

Polybrominated biphenyl ethers (PBBEs), commonly used as flame retardants, were determined in organisms and sediments in Japan. Tetra-BBE was found in 7 out of 17 samples of marine organisms (highest level, 14.6 microgram/kg wet weight in marine mussel). Levels of tetra-BBE were about the same as hexachlorobenzene levels and about 1% of polychlorinated biphenyl (PCB) levels. Pollution of marine organisms by other PBBEs was negligible. In sediments decabrominated biphenyl ether was found in all river sediment samples from Osaka (33 to 380 microgram/kg dry weight). These levels were significantly more than those of hexachlorobenzene and about 10% of those of PCBs. Except for one sample, no decabrominated biphenyl ether was found in estuary sediments. PCBs and polychlorinated terphenyls were present in estuary and river sediments, with higher levels in the estuary sediments. (Cassar-PTT)
W89-00610

CREOSOTE COMPOUNDS IN SNAILS OBTAINED FROM PENSACOLA BAY, FLORIDA, NEAR AN ONSHORE HAZARDOUS-WASTE SITE,
Geological Survey, Denver, CO.
C. E. Rostad, and W. E. Pereira.
Chemosphere CMSHAF, Vol. 16, Nos. 10-12, p 2397-2404, 1987. 2 tab, 33 ref.

Descriptors: *Hazardous wastes, *Creosote, *Pentachlorophenol, *Hydrocarbons, *Pensacola Bay, *Florida, *Path of pollutants, Groundwater contamination, Waste disposal, Snails, Aquifers, Marine animals, Organic compounds, Indicators, Bioindicators, Bioaccumulation, Accumulation.

Snails, Thais haemostoma, were collected from two areas offshore in Pensacola Bay, Florida, near an onshore hazardous waste site where wood treatment wastes (creosote and pentachlorophenol) had been used for 80 years. Some contaminated groundwater had entered the bay via a stream. Along with naturally occurring compounds, the snail tissue contained large concentrations of polycyclic aromatic compounds characteristic of creosote contamination, such as naphthalene, phenanthrene, dibenzothiophene, dibenzofuran, and benzo(a)pyrene. Some nitrogen heterocycles were also found in snail tissue: 2-quinoline, acridine, carbazole, and acridinone. These were also indicative of creosote contamination. (Cassar-PTT)
W89-00611

BIOGEOCHEMISTRY OF BENZ(A)ANTHRACENE AT THE SEDIMENT-WATER INTERFACE,
Massachusetts Univ. at Boston. Environmental Science Program.
A. E. McElroy, B. W. Tripp, J. W. Farrington, and J. M. Teal.
Chemosphere CMSHAF, Vol. 16, Nos. 10-12, p 2429-2440, 1987. 3 fig, 3 tab, 21 ref. U.S. Department of Energy Grant DE-AC02-77EV04256 A007 and Interagency Agreement AA550-IA7-20.

Descriptors: *Geochemistry, *Fate of pollutants, *Aromatic compounds, *Hydrocarbons, *Benzanthracene, Marine animals, Polychaetes, Benthos, Degradation, Biodegradation, Sediment-water interfaces, Carbon radioisotopes, Isotope studies, Radioactive tracers, Tissue analysis.

Two recirculating microcosms were used to study the fate of the polycyclic aromatic hydrocarbon benz(a)anthracene (BA) near the sediment-water interface. In the absence of direct sunlight, degradation of C-14-labeled BA added to the water column was investigated in the water column, in the sediment reservoir, and in the polychaete Nephtys incisa. After 42 days, 98% of the recovered radioactivity was found in the sediment, of which 97% was in the top 2 cm. The presence of worms in half of the sediment reservoir in each chamber did not measurably alter the distribution of BA-derived radioactivity. Very little of the recovered radioactivity was recovered from the worms. Most of the C-14 remaining in the water column was in the form of dissolved carbon dioxide. (Cassar-PTT)
W89-00612

ANALYSIS OF HALOGENATED POLYCYCLIC AROMATIC HYDROCARBONS IN URBAN AIR, SNOW AND AUTOMOBILE EXHAUST,
Stockholm Univ. (Sweden). Dept. of Analytical Chemistry.
P. Haglund, T. Alsberg, A. Bergman, and B. Jansson.
Chemosphere CMSHAF, Vol. 16, Nos. 10-12, p 2441-2450, 1987. 3 fig, 1 tab, 17 ref. Sweden National Environmental Protection Board Grant 5315256-7 and 5323116-3.

Descriptors: *Path of pollutants, *Air pollution, *Hydrocarbons, *Urban areas, *Polycyclic aromatic hydrocarbons, *Aromatic compounds, Snow, Organic compounds.

Urban air, snow, and automobile exhaust samples were analyzed for halogenated polycyclic aromatic hydrocarbons (xPAHs). The exhaust samples and air samples contained brominated, bromochlorinated and chlorinated PAHs. Only 1-chloropyrene was identified due to the lack of reference compounds. The air sample contained about 10 pg/cu m of 1-chloropyrene, with a gas phase/particulate phase ratio of about 1/3. The snow samples contained xPAHs in particulate matter extracts but not in aqueous extracts. Concentrations decreased exponentially with increasing distance from the road. The source of pollution of the snow was believed to be automobile exhaust. The exhaust sample was obtained from a car run on leaded gasoline containing ethylene dichloride and ethylene dibromide, which are probably the source of halogen atoms in the xPAH detected in the exhaust. (Cassar-PTT)
W89-00613

CHLORINATED HYDROCARBONS IN SEDIMENTS OF THE ELBE RIVER AND THE ELBE ESTUARY,
Alfred-Wegener-Inst. fuer Polarforschung, Bremerhaven (Germany, F.R.).
G. Eder, R. Sturm, and W. Ernst.
Chemosphere CMSHAF, Vol. 16, Nos. 10-12, p 2487-2496, 1987. 2 tab, 12 ref.

Descriptors: *Path of pollutants, *Elbe River, *Germany, *Chlorinated hydrocarbons, *Sediments, *Pesticides, Insecticides, Pentachlorobenzene, Hexachlorobenzene, Polychlorinated biphenyls, Octachlorostyrene, DDT, DDE, DDD, Hexachlorocyclohexane, Rivers, Estuaries.

Sediment samples from the Elbe River and Estuary were analyzed for organic micropollutants by three different gas chromatographic methods.

Methods 1 and 3 both used solvent extraction and shared one sample. Their results generally agreed well, with Method 1 having slightly higher values. Method 2 gave recovery rates near 100%, except for alpha hexachlorocyclohexane, 85%. Concentrations of the following compounds were reported: hexachlorocyclohexane, hexachlorobenzene, polychlorinated biphenyls, pentachlorobenzene, octachlorostyrene, and DDT and metabolites. (Cassar-PTT)
W89-00614

EVALUATION OF AQUATIC ENVIRONMENTAL FATE OF 2,4,6-TRICHLOROPHENOL WITH A MATHEMATICAL MODEL,
Mitsubishi-Kasei Inst. of Toxicological and Environmental Sciences, Yokohama (Japan).
K. Yoshida, T. Shigeoka, and F. Yamauchi.
Chemosphere CMSHAF, Vol. 16, Nos. 10-12, p 2531-2544, 1987. 6 fig, 3 tab, 14 ref.

Descriptors: *Fate of pollutants, *Phenols, *Photodegradation, *Biodegradation, *Trichlorophenol, Oligotrophic lakes, Eutrophic lakes, Kinetics, Model studies, Mathematical models, SAFECAS model, Mass transfer, Sediments, Volatilization, Kinetics, Biodegradation, Lakes, Rivers, Degradation, Advection.

A mathematical model, Simplified Approach for Fate Evaluation of Chemicals in Aquatic Systems (SAFECAS), was applied to evaluate the fate of 2,4,6-trichlorophenol (TCP) in three types of aquatic environments: a river, an oligotrophic lake, and a eutrophic lake. Results suggest that most of the TCP is distributed to the water phase in aquatic environments and is rapidly removed by advective outflow in the river and by photodegradation in lakes. Biodegradation in sediment contributes less than 0.1% of total removal mass under steady state. The pKa of chemicals and pH of the aquatic systems are important factors in evaluation of fate and concentrations of dissociative substances in aquatic environments. (Cassar-PTT)
W89-00616

STUDIES OF THE OXIDATIVE PHOTOINDUCED DEGRADATION OF SILICONES IN THE AQUATIC ENVIRONMENT,
Bayer A.G., Leverkusen (Germany, F.R.).
C. Anderson, K. Hochgeschwender, H. Weidemann, and R. Wilmes.
Chemosphere CMSHAF, Vol. 16, Nos. 10-12, p 2567-2577, 1987. 3 fig, 2 tab, 12 ref.

Descriptors: *Fate of pollutants, *Degradation, *Silicones, *Polymers, *Photodegradation, Silicates, Oxidation, Nitrates, Artificial sunlight.

Aqueous solutions of water-soluble oligomeric dimethylsiloxanes were irradiated with artificial sunlight in the presence of nitrates, reducing the concentration of the siloxanes. In two separate experiments, half lives of 9 and 4 days were determined. The final product of photodegradation was silicate; transformation was nearly complete after 35 days. Using high molecular-weight poly(dimethylsiloxane) aqueous emulsions in the presence of nitrates, a level of silicate corresponding to 1.7% of the original material was found after 5 weeks. The very slow degradation of the poly(dimethylsiloxane) was attributed to its very low solubility in water. This permits only a monomolecular surface layer of the polymer to react with the hydroxyl radicals formed in water. (Cassar-PTT)
W89-00617

CONTRIBUTIONS OF HEAVY METALS FROM MUNICIPAL RUNOFF TO THE SEDIMENTS OF LAKE PONTCHARTRAIN, LOUISIANA,
New Orleans Univ., LA. Center for Bio-Organic Studies.
C. J. Byrne, and I. R. DeLeon.
Chemosphere CMSHAF, Vol. 16, Nos. 10-12, p 2579-2583, 1987. 1 fig, 1 tab, 10 ref.

Descriptors: *Water pollution sources, *Path of pollutants, *Heavy metals, *Urban runoff, *Sediments, *Lake Pontchartrain, *Louisiana, Metals, Barium, Copper, Nickel, Lead, Zinc, Runoff, Storm runoff, Navigable waters.

The distribution and sources of heavy metal pollutants found in the sediments of Lake Pontchartrain was studied at eight locations. Concentrations of the metals of interest (barium, copper, nickel, lead, and zinc) indicated that the principal sources of heavy metal pollution were associated with urban stormwater runoff and municipal and industrial discharges. The Tchefuncta River mouth, reflecting a rural area, had the lowest metals concentrations. The Bayous Liberty/Bonfouca station, draining residential areas, had high zinc and nickel levels, indicative of the ship repair facilities in the upper reaches of the bayou. At the Inner Harbor Navigation Canal inlet metals levels were high; these were associated with ship repair/building and manufacturing and municipal and industrial discharges. The 17th Street Canal, a major stormwater runoff canal for New Orleans, had the highest concentrations of lead, copper, and zinc. Metals concentrations at other stations were consistent with population density. (Cassar-PTT)
W89-00618

COMPARISON OF DRINKING WATER MUTAGENICITY WITH LEACHING OF POLYCYCLIC AROMATIC HYDROCARBONS FROM WATER DISTRIBUTION PIPES,
Syracuse Research Corp., NY. Life and Environmental Sciences Div.
For primary bibliographic entry see Field 5C.
W89-00619

EFFECT OF PH AND CONTACT TIME ON THE CONCENTRATION OF AS(III) AND AS(V) IN COAL ASH SYSTEMS,
Georgia Univ., Sapelo Island. Marine Inst.
For primary bibliographic entry see Field 5E.
W89-00624

SIZE DISTRIBUTION AND COPPER ASSOCIATION OF DISSOLVED ORGANIC MATERIAL IN URBAN RUNOFF,
Chalmers Univ. of Technology, Goeteborg (Sweden). Dept. of Sanitary Engineering.
G. M. P. Morrison, and G. Diaz-Diaz.
Environmental Technology Letters ETLEDB, Vol. 9, No. 2, p 109-116, February 1988. 3 fig, 2 tab, 23 ref.

Descriptors: *Particle size, *Copper, *Dissolved solids, *Organic matter, *Runoff, *Urban runoff, Path of pollutants, Flood hydrograph, Heavy metals, Chromatography, Storm runoff, Colloids, Chelation, Chemical analysis, Water analysis, Pollutant identification, Water pollution sources.

Dissolved organic material in filtered urban runoff samples was fractionated by gel filtration chromatography. Two distinct organic fractions were isolated on a column of Sephadex G25, with K sub D value ranges of 0.1-0.3 and 0.5-0.9. The first fraction tended towards a 'first flush' on the stormwater hydrograph, while the second fraction was characterized by a late loading and no evidence of exhaustion. Both fractions had Cu complexation properties. Fraction 1 showed the greatest degree of Cu complexation with a total capacity of 49.5 mM/g organic C. (Author's abstract)
W89-00628

CHLOROPICRIN IN POTABLE WATER: CONDITIONS OF FORMATION AND PRODUCTION DURING TREATMENT PROCESSES (LA CHLOROPICRINE DANS LES EAUX POTABLES: CONDITIONS DE FORMATION ET EVOLUTION LE LONG DES FILIERES DE TRAITEMENT),
Centre de Recherche Lyonnaise des Eaux - Degremont, Le Pecq (France).
For primary bibliographic entry see Field 5F.
W89-00635

INVESTIGATION OF TRANSPORT-PROCESSES ALONG THE ELBE RIVER USING CHERNOBYL RADIONUCLIDES AS TRACERS,
Technische Univ. Hamburg-Harburg (Germany, F.R.).
J. Schoer.
Environmental Technology Letters ETLEDB, Vol. 9, No. 4, p 317-324, April 1988. 4 fig, 2 tab, 12 ref.

Descriptors: *Isotope studies, *Europe, *Fallout, *Sediment transport, *Radioactive tracers, *Chernobyl accident, *Path of pollutants, Elbe River, Suspended solids, Radioisotopes, Ruthenium radioisotopes, Cesium radioisotopes, Zirconium, Heavy metals, Travel time.

The radionuclides deposited inhomogeneously in middle Europe after the Chernobyl accident were used to investigate the transport terms of water and suspended matter in the Elbe River between Czechoslovakia and the North Sea. Though the deposition rates were one order of magnitude higher in Czechoslovakia compared with northern Germany, there was no significant peak indicating the arrival of the more contaminated water from upstream, probably because the contaminated water arrived at the same time at the sampling station as local precipitation of Chernobyl fall-out occurred. From this, a running time of about 8 days could be concluded. The observed variations of the specific activities of Cs-137 and the Ru-103 in suspended matter resulted mainly from a change in solid material properties. But from the specific activities of Nb-95 and Zr-95, which were mainly deposited in the upstream drainage basin, the transport duration of suspended matter along the river at mean discharge could be calculated to be at least 4 weeks. (Author's abstract)
W89-00636

MERCURY INPUTS INTO THE AMAZON REGION, BRAZIL,
Universidade Federal do Rio de Janeiro (Brazil). Inst. de Biofisica.
W. C. Pfeiffer, and L. Drude de Lacerda.
Environmental Technology Letters ETLEDB, Vol. 9, No. 4, p 325-330, April 1988. 2 fig, 3 tab, 6 ref.

Descriptors: *Mercury, *Water pollution sources, *Amazon, *Metal-finishing wastes, *Mineral industry, Gold, Rivers, Path of pollutants, Heavy metals, Brazil.

Mercury inputs into the Brazilian Amazon ecosystem due to goldmining activities are quantified based on data from various Brazilian Mineral and Environmental Agencies as well as field work. Total losses of Hg were estimated to be 1.32 kg Hg/kg Au, from which 45% are released into rivers and 55% into the atmosphere. Total Hg input to the Amazon may contribute with up to 6% of the global anthropogenic Hg emissions to the atmosphere, and the releases into the rivers are at the same order of magnitude as the inputs into the North Sea. (Author's abstract)
W89-00637

MERCURY POLLUTION IN THE ESTUARINE REGION AROUND BOMBAY ISLAND,
Indian Inst. of Tech., Bombay. Centre for Environmental Science and Engineering.
B. A. Mahajan, and M. Srinivasan.
Environmental Technology Letters ETLEDB, Vol. 9, No. 4, p 331-336, April 1988. 1 fig, 2 tab, 20 ref.

Descriptors: *Mercury, *Water pollution, Estuarine environment, *India, *Bioaccumulation, *Bombay, Sediments, Shellfish, Fish, Environment, Heavy metals, Tissue analysis, Accumulation, Crabs, Crustaceans, Mollusks, Gastropods, Chemical analysis, Water pollution sources, Catfish, Fate of pollutants, Thana Greek.

Quantitative estimation of mercury in sediments and organisms from two estuarine regions around Bombay is presented. These estuarine regions receive and effluents from the majority of the chemical industries serve also as a source for seafood for a limited local population. Mercury analysis was done for two major seasons, post-monsoon and

pre-monsoon. One of the regions (Thana Creek) showed higher mercury content in sediments and organisms than has been reported previously, showing that there is a steady build-up of this metal in the biota due to anthropogenic influence. The quantitative pattern of mercury in the organisms can be ranked as follows: bivalve > benthic fish > crab > prawn > gastropod > pelagic fish. (Author's abstract)
W89-00638

FIELD MEASUREMENTS OF WATER-AIR EXCHANGE OF MERCURY IN FRESHWATER SYSTEMS,
Atmospheric Environment Service, Downsview (Ontario).
For primary bibliographic entry see Field 5A.
W89-00640

PARTITIONING OF ORGANOCHLORINES BETWEEN WATER, PARTICULATE MATTER AND SOME ORGANISMS IN ESTUARINE AND MARINE SYSTEMS OF THE NETHERLANDS,
Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
E. K. Duursma, J. Nieuwenhuize, J. M. VanLiere, and M. J. T. Hillebrand.
Netherlands Journal of Sea Research NJSRBA, Vol. 20, No. 2/3, p 239-251, August 1986. 6 fig, 6 tab, 22 ref.

Descriptors: *Path of pollutants, *Estuaries, *Chemical properties, *Polychlorinated biphenyls, Particulate matter, Partitioning, Organochlorines, Delta region, North Sea, Wadden Sea, Marine environment, Salinity, The Netherlands.

The distribution of organochlorides in estuarine and marine systems, and in particular those of individual PCB components have been analyzed for the partitioning of these substances between water, particulate matter (Seston), plankton, worms, shellfish, fish and some birds. The K sub d concept has been used to investigate the ratio between solid substrates and water. Additionally, an attempt has been made to investigate the regression coefficient of K sub ds with a polarity index of the individual PCB components. This K sub d - IUPAC Number regression has been carried out for samples from the Delta region, the North Sea and the Wadden Sea. For the North Sea and the Wadden Sea, existing concentrations from unpublished reports have been taken. Two major results have been obtained: (1) Organochlorine concentrations in mussels can be successfully correlated to salinities of estuarine waters, if the sources of organochlorines are linked to the major fresh waters of the estuarine system. This correlation is independent of the seasonal changes in condition of these organisms by fat content, if the record is made for a period of two years. (2) These results demonstrate for aquatic organisms a degree of consistency in the K sub d levels if concentrations in the organisms are calculated on fat basis. (Author's abstract)
W89-00672

DISTRIBUTION OF ARSENIC IN THE SEDIMENTS AND BIOTA OF HILO BAY, HAWAII,
Hawaii Univ. at Hilo. Div. of Natural Sciences.
L. E. Hallacher, E. B. Kho, N. D. Bernard, A. M. Orcutt, and W. C. Dudley.
Pacific Science PASCAP, Vol. 39, No. 3, p 266-273, July 1985. 4 fig, 2 tab, 11 ref. University of Hawaii, Office of Research Administration, Research and Training Revolving Fund Award 21 S 83 381 F 729 E 165.

Descriptors: *Fate of pollutants, *Arsenic, *Sediments, *Hilo Bay, *Hawaii, *Water pollution sources, *Pollutants, Waiakea Mill Pond, Wailoa River Estuary.

Sediment samples collected from the Waiakea Mill Pond, Wailoa River and Hilo bay were analyzed for arsenic. Arsenic was detectable in 10 of 11 sediment samples, and ranged in concentration from 2 to 715 ppm. Two species of plant and seven species of animal were collected from the Waiakea Mill Pond and analyzed for arsenic. No arsenic was detected in the plants, whereas four of the seven animal species had arsenic concentrations ranging from a trace to 1.3 ppm. Sediments of the Wailoa River estuary have much higher concentrations of arsenic than those of Hilo Bay, indicating that most arsenic is located near the original source of pollution, a factory that once operated on the shores of the Waiakea Mill Pond. Much of the arsenic was found in anaerobic regions of the sediment where it has been relatively undisturbed by biological activity. The low levels of arsenic in the biota of the estuary suggest that there is little remineralization of the region's arsenic and that it is trapped in anaerobic sediment layers. (Author's abstract)
W89-00677

CONTAMINATION OF SURFACE SEDIMENTS OF THE PRINCIPAL RIVERS OF GENEVA CANTON BY POLYCHLORINATED BIPHENYLS AND DDT (CONTAMINATION DES SEDIMENTS SUPERFICIELS DES PRINCIPALES RIVIERES DU CANTON DE GENEVE PAR LES POLYCHLOROBIPHENYLES ET DDT),
National Kaohsiung Inst. of Tech. (Taiwan).
C. Corvi, and J. Vogel.
Schweizerische Zeitschrift fuer Hydrologie SZHYA6, Vol. 47, No. 1, p 12-20, December 1985. 3 fig, 1 tab, 7 ref. English summary.

Descriptors: *Polychlorinated biphenyls, *Switzerland, *Rivers, *DDT, *Geneva, *Bottom sediments, *Water pollution sources, Sampling, Stream pollution, Water pollution, Effluents, Municipal, Urbanization, Switzerland, Rhone River, Catchment areas, Spatial distribution, Pesticides, Arochlor, Path of pollutants.

PCB concentrations in sediments of important rivers of Geneva Canton Switzerland were determined. The samples were collected, in general, when the water level was at its lowest. In addition, Rhone River sediment samples were collected during the drainage of the Verbois Dam. Analyses were performed on fractions sieved through 63 um sieves. PCBs were extracted with acetonitrile using a batch technique. Then clean-up was done on a florisil column and PCB concentrations in the extracts were determined by gas-liquid chromatography using a capillary column and an electron capture detector. Quantitative results were found by pattern comparison with standard mixtures of Arochlor 1242, 1254 and 1260. In the case of the Rhone River sediments, the PCB concentrations observed at the surface were fairly low, except that higher values were found at town crossings or at tributary inlets where there was spot pollution. As for the other rivers, contamination appeared to be related to the urbanization along the river banks or to effluent wastewater from water treatment plants. Analysis of deeper layers seems to suggest a significant contribution from past pollution. The overall picture of PCB contamination of the hydrographic network of Geneva has not changed since 1980. (Author's abstract)
W89-00690

INTERPRETATION OF METAL PROFILES IN A SEDIMENT CORE FROM LAKE GENEVA: METAL MOBILITY OR POLLUTION,
Academia Sinica, Beijing (China). Inst. of Environmental Chemistry.
Z. J. Wang, H. El Ghobary, F. Giovanoli, and P. Y. Favarger.
Schweizerische Zeitschrift fuer Hydrologie SZHYA6, Vol. 48, No. 1 , p 1-17, October 1986. 9 fig, 4 tab, 52 ref.

Descriptors: *Sediment-water interfaces, *Lake Geneva, *Path of pollutants, *Lake sediments, *Heavy metals, *Sediment-water interfaces, *Switzerland, *Water pollution sources, Manganese, Sulfides, Solute transport, Iron, Cobalt, Zinc, Copper, Chromium, Oxidation-reduction potential, Lead, Phosphorous, Lakes, Oxides.

The transition elements Mn, Fe, Co, Zn, Cu and Cr together with Pb and P were determined in three sequential extractions of sediments and in the pore water of a 35-cm sediment core from Lake Geneva (Switzerland). A high percentage of the mobile Mn, Fe, P, Co, Pb and Zn was extracted in the first (inorganic) fraction, whereas the mobile Cu and Cr were mostly found in the second (organic and sulfide) fraction. Mn was subject to recycling with solubilization from the surface sediment of the oxic bottom water where it was precipitated. Highly enriched Co and P values were observed in the top few mm of the sediment resulting from post depositional solubilization with upward migration and precipitation with oxi-hydroxides at the sediment surface. The slower increase of Cu, Zn and Pb concentrations towards the sediment/water interface are the result of an increase of anthropogenic sources over the past decades. A further increase in Pb in the first cm of the core is believed to be related to the freshly precipitated Mn oxi-hydroxides. (Author's abstract)
W89-00694

ROLE OF CHEMICAL WEATHERING IN THE NEUTRALIZATION OF ACIDIC DEPOSITION,
Iowa Univ., Iowa City. Dept. of Civil and Environmental Engineering.
J. L. Schnoor, and W. Stumm.
Schweizerische Zeitschrift fuer Hydrologie SZHYA6, Vol. 48, No. 2, p 171-195, December 1986. 8 fig, 4 tab, 86 ref.

Descriptors: *Weathering, *Sulfates, *Ion exchange, *Neutralization, *Acid rain, *Hydrogen ion concentration, Catchment areas, Alkalinity, Chemical properties, Chemistry of precipitation, Self-purification, Geochemistry, Kinetics, Surface-groundwater relations, Hydrologic models, Rocks, Sedimentary rocks.

Chemical weathering of rocks and minerals is a key factor that mitigates acidic deposition and affects water chemistry. It supplies cations and alkalinity to the surface water, groundwater, ion-exchange complex, and vegetation in the watershed. The kinetics of chemical weathering have not been determined in the field, but based on laboratory experiments, the rate of weathering has a fractional order dependency on hydrogen ion and organic ligand concentration in bulk solution. Watersheds with the greatest degree of hydrologic and geologic sensitivity can produce only 200-500 eq/ha/yr of cations or alkalinity for export. This is equivalent to 100 cm/yr of precipitation with a pH of 4.3-4.6 or an annual sulfur deposition of 1.0-2.5 g S/sq m/yr. When acid and sulfur deposition are greater than these levels, extremely sensitive lakes may become acidified. To illustrate this point, a simple steady-state model is applied to lakes in regions where acidification of lakes has been reported. (Author's abstract)
W89-00696

DISPERSION IN HETEROGENEOUS POROUS MEDIA: 1. LOCAL VOLUME AVERAGING AND LARGE-SCALE AVERAGING,
Washington State Univ., Pullman. Dept. of Mechanical Engineering.
O. A. Plumb, and S. Whitaker.
Water Resources Research WRERAO, Vol. 24, No. 7, p 913-926, July 1988. 10 fig, 70 ref. NSF Grants CPE 83-08461, CTB-85 13956, and CBT-84 18497.

Descriptors: *Path of pollutants, *Solute transport, *Porous media, *Groundwater movement, *Mathematical models, *Diffusion, *Dispersion, Mathematical equations, Convective-dispersion equation, Temporal distribution.

The problem of diffusion and dispersion in porous media is considered in the absence of either adsorption or chemical reaction. For this situation, local volume averaging has been used to obtain both a convective-dispersion equation and a method of closure that provides for a direct theoretical prediction of the dispersion tensor. This approach is associated with 3 length scales, the pore diameter, the radius of the averaging volume, and the macroscopic length scale, and makes use of a representative unit cell to determine the dispersion tensor.

Previous work suggests that extremely complex unit cells must be used to capture the observed dispersion phenomena, and complex unit cells naturally introduce another length scale, i.e., the length scale associated with the local heterogeneities. The use of large-scale averaging to account for the influence of the local heterogeneities is proposed to deal with this problem. This leads to a large-scale convective-dispersion equation that contains additional terms involving time derivatives which arise as a result of the presence of heterogeneities and which do not appear in the conventional local volume average convection-dispersion equation. The first new term contains the second derivative with respect to time and is likely to be unimportant for time scales appropriate for groundwater transport processes; however, it may be important for small-scale laboratory experiments. The second new term contains a mixed space-time derivative which may be important for many cases of practical interest. A closure scheme is presented that allows for the theoretical determination of all the coefficients that appear in the large-scale convective-convection-dispersion equation. (See also W89-00700) (Author's abstract)
W89-00699

DISPERSION IN HETEROGENEOUS POROUS MEDIA: 2. PREDICTIONS FOR STRATIFIED AND TWO-DIMENSIONAL SPATIALLY PERIODIC SYSTEMS,
Washington State Univ., Pullman. Dept. of Mechanical Engineering.
O. A. Plumb, and S. Whitaker.
Water Resources Research WRERAO, Vol. 24, No. 7, p 927-938, July 1988. 9 fig, 2 tab, 30 ref. NSF Grants CPE 83-08461, CBT-85 13956, and CBT-84 18497.

Descriptors: *Porous media, *Groundwater movement, *Mathematical models, *Path of pollutants, *Solute transport, *Diffusion, *Dispersion, Mass transport, Spatial distribution, Closure, Mathematical equations, Prediction.

The closure scheme presented in Part 1 is solved for a stratified system and for a two-dimensional spatially periodic system. By this it is meant that the omega and nu regions , which make up the heterogeneous media, are distributed in a spatially periodic manner. The solution to the closure problem yields the information necessary to determine the large-scale dispersion tensor and the other coefficients that appear in the large-scale dispersion equation. The theoretical results for the stratified system exhibit an increase in the longitudinal dispersion coefficient of several orders of magnitude over that which would be predicted using established correlations based on laboratory experiments with seemingly homogeneous porous media. For the cases studied, the coefficient of the mixed space-time derivative appears to be significant and this coefficient increases for those conditions which yield increasing longitudinal dispersion coefficients. The results for the two-dimensional spatially periodic system are in qualitative agreement with experimental observations. Both the size of the heterogeneity and the difference in the hydraulic conductivity between the two regions had an important influence on the large-scale dispersion tensor. As in the case of a stratified medium, the predicted values of the coefficient of the mixed space-time derivative (the skewness vector) indicate that this term could be a significant factor in the prediction of mass transport in heterogeneous porous media. (See also W89-00699) (Author's abstract)
W89-00700

DRAINAGE BASIN CONTROL OF ACID LOADINGS TO TWO ADIRONDACK LAKES,
Clarkson Univ., Potsdam, NY. Dept. of Civil and Environmental Engineering.
W. G. Booty, J. V. DePinto, and R. D. Scheffe.
Water Resources Research WRERAO, Vol. 24, No. 7, p 1024-1036, July 1988. 10 fig, 1 tab, 23 ref.

Descriptors: *Path of pollutants, *Watersheds, *Lakes, *Acid rain, *New York, *Hydrologic models, Groundwater retention, Catchment area, Woods Lake, Cranberry Pond, Pollution load.

Two adjacent Adirondack Park (New York) calibrated watersheds (Woods Lake and Cranberry Pond) which receive identical atmospheric inputs, generate significantly different unit area of watershed loading rates of acidity to their respective lakes. A watershed acidification model is used to evaluate the watershed parameters which are responsible for the observed differences in acid loadings to the lakes. The greater overall mean depth of overburden on Woods Lake watershed, which supplies a greater buffer capacity as well as a longer retention time of groundwater, appears to be the major factor responsible for the differences. (Author's abstract)
W89-00710

ALKALINITY REGULATION IN SOFTWATER FLORIDA LAKES,
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
For primary bibliographic entry see Field 2H.
W89-00714

THREE-DIMENSIONAL RADIAL DISPERSION IN A VARIABLE VELOCITY FLOW FIELD,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
S. R. Yates.
Water Resources Research WRERAO, Vol. 24, No. 7, p 1083-1090, July 1988. 5 fig, 1 tab, 19 ref, append.

Descriptors: *Mathematical models, *Path of pollutants, *Plumes, *Solute transport, *Fate of pollutants, *Aquifers, *Groundwater movement, Radial dispersion, Pollution load, Discharge flow, Mathematical models, Isotropy, Wells.

An analytical solution is developed which provides a 3-dimensional solution for the fate and transport of contaminants in a variable velocity and axially symmetric flow field. Due to the axially symmetric nature of the flow field, the equations which describe the transport process and linear retardation of the contaminant and assumes that the aquifer is homogeneous and isotropic. Two solution techniques are used and approximate early and late time solutions are presented. The analytical solution is illustrated by several examples using three different boundary conditions at the well. (Author's abstract)
W89-00715

STREAM CHEMISTRY IN THE NEW JERSEY PINELANDS: THE INFLUENCE OF PRECIPITATION AND WATERSHED DISTURBANCE,
Rutgers - The State Univ., Camden, NJ. Dept. of Biology.
M. D. Morgan, and R. E. Good.
Water Resources Research WRERAO, Vol. 24, No. 7, p 1091-1100, July 1988. 6 fig, 6 tab, 5 ref.

Descriptors: *Path of pollutants, *Land development, *Streams, *Acid rain, *Wetlands, *New Jersey Pinelands, Chemical properties, Aluminum, Iron, Hydrogen ion concentration, Ammonium, Calcium, Magnesium, Sodium, Potassium, Chlorides, Sulfates, Nitrates, Tracers, Ecosystems, Watersheds, Agriculture.

Bulk precipitation chemistry in the New Jersey Pinelands from July 1984 to July 1986 was influenced by both marine and continental air masses. The marine air masses were less acidic and dominated by Cl(-), Na(+), and Mg(2+) while the continental air masses were high in ions typical of acid rain in the northeastern United States (SO4(2-), H(+), and NO3(-). Over the same period, Pinelands streams draining undisturbed watersheds were acidic and very low in dissolved substances. The dominant ions were Na(+) and Cl(-), followed by SO4(2-), Mg(2+), H(+), and Ca(2+). Streams draining watersheds disturbed by residential and agricultural development exhibited elevated concentrations of Ca(2+), Mg(2+), K(+), SO4(2-), and NO3(-), and lower H(+). The altered levels of each of these of these ions was directly related to inputs from human activities and illustrated the sensitivity of Pinelands ecosystems to disturbance. Using Cl(-) as a tracer, enrichment factors were calculated for the major solutes. In undisturbed streams the enrichment factors showed that Na(+) and K(+) were passed through the system and that H(+), Ca(2+), NH4(+), NO3(-), and SO4(2-) were retained. Of the measured materials only Mg(2+) was exported from undisturbed streams, although previous work has shown that iron, aluminum, and organic matter are also exported. The retention of SO4(2-) was probably related to sulfate reduction in the extensive wetland systems of the Pinelands. These data strongly support earlier work that suggested sediment weathering in the Pinelands contributes few of the measured ionic constituents to stream discharge. Undisturbed Pinelands stream chemistry appears to be highly dependent on precipitation input and is modified primarily by biological activity within this ecosystem. (Author's abstract)
W89-00716

MICROSCALE HALINE CONVECTION - A PROPOSED MECHANISM FOR TRANSPORT AND MIXING AT THE WATER TABLE REGION,
Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.
For primary bibliographic entry see Field 2F.
W89-00718

PREDICTING REGIONAL EPISODIC ACIDIFICATION OF SURFACE WATERS USING EMPIRICAL MODELS,
Northrop Services, Inc., Corvallis, OR. Environmental Research Lab.
K. N. Eshleman.
Water Resources Research WRERAO, Vol. 24, No. 7, p 1118-1126, July 1988. 6 fig, 3 tab, 60 ref. EPA Contract 68-03-3246.

Descriptors: *Acid rain, *Surface water, *Lakes, *Streams, Mathematical models, *Acidic water, *Hydrologic models, United States, Mixing, Adirondacks, Prediction, Acid neutralizing capacity, Catchment areas, Path of pollutants.

Studies of individual lakes and streams have documented the occurrence of transient, short-term acidification of surface waters during hydrologic events, but a regional assessment of episodic chemical effects has not been made. Application of a two-box mixing model, together with regional chemistry and deposition data, indicates that acidic episodes (acid neutralizing capacity < 0) are likely an important regional phenomenon. Population estimates of the total proportion of acidic stream reaches increased by 40-640% in six subregions of the eastern United States when episodes were taken into account. Data from a small sample of lakes in the Adirondacks (which appear to be representative of the lake population) show that fall 'index' acid neutralizing capacity (ANC) is an excellent predictor of the minimum episodic ANC measured at the outlets of these lakes during spring snowmelt. While 11% of the Adirondack lakes were acidic at fall overturn, a linear regression model predicts that more than 35% were acidic at their outlets during the spring of 1986. (Author's abstract)
W89-00719

CONJUGAL TRANSFER OF R68.45 AND FP5 BETWEEN PSEUDOMONAS AERUGINOSA STRAINS IN A FRESHWATER ENVIRONMENT,
Stritch School of Medicine, Maywood, IL. Dept. of Biochemistry and Biophysics.
S. B. O'Morchoe, O. Ogunseitan, G. S. Sayler, and R. V. Miller.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 8, p 1923-1929, August 1988. 6 fig, 5 tab, 23 ref. EPA Cooperative Agreement CR12494.

Descriptors: *Path of pollutants, Fate of pollutants, *Genetic pollutants, *Plasmids, *Pseudomonas, Aquatic environment, Genetic engineering, Gene transfer, Conjugation, Lakes, Reservoirs, Natural waters, Microorganisms, Simulation.

Recent concern over the release of genetically-engineered organisms has resulted in a need for information about the potential for gene transfer in the environment. The conjugal transfer in Pseudomonas aeruginosa of the plasmids R68.45 and FP5 was demonstrated in the freshwater environment of Fort Loudoun Reservoir, Knoxville, TN. When genetically-well-defined plasmid donor and recipient strains were introduced into test chambers suspended in Fort Loudoun Lake, transfer of both plasmids was observed. Conjugation occurred both in the presence and absence of the natural microbial community. The number of transconjugants recovered was lower when the natural community was present. Transfer of the broad-host-range plasmid R68.45 to organisms other than the introduced recipient was not observed in these chambers but was observed in laboratory simulations when an organism isolated from lakewater was used as the recipient strain. Although the plasmids transferred in laboratory studies were genetically and physically stable, a significant number of transconjugants recovered from the field trials contained deletions and other genetic rearrangements, suggesting that factors which increase gene instability were operating in the environment. The potential for conjugal transfer of genetic material must be considered in evaluating the release of any genetically-engineered microorganism into a freshwater environment. (Author's abstract)
W89-00728

EFFECTS OF ACIDIFICATION ON MERCURY METHYLATION, DEMETHYLATION, AND VOLATILIZATION IN SEDIMENTS FROM AN ACID-SUSCEPTIBLE LAKE,
Wisconsin Univ.-La Crosse. River Studies Center.
R. J. Steffan, E. T. Korthals, and M. R. Winfrey.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 8, p 2003-2009, August 1988. 6 fig, 39 ref.

Descriptors: *Path of pollutants, *Water pollution effects, *Lake sediments, *Acid rain effects, *Fate of pollutants, *Acidic water, *Methylmercury, *Biotransformation, Methylation, Demethylation, Volatility, Radioactive tracers, Wisconsin, Hydrogen ion concentration, Sulfuric acid, Nitric acid, Hydrochloric acid, Nitrates, Inhibition, Fish.

The experimental-acidification effect on mercury transformations was examined in surficial sediment samples from a weakly-buffered northern Wisconsin lake. All transformations were measured with radioisotopic tracers. Acidification of sediment pH with sulfuric, hydrochloric, or nitric acid significantly decreased Hg-203(++) methylation. Acidification of pH 6.1 (ambient) sediments to pH 4.5 with either sulfuric or hydrochloric acid inhibited methylation by > 65%. Since methylation was not affected by concentrations of sodium sulfate or sodium chloride equimolar to the amount of acid added, the decreased methylation must have been due to increased hydrogen-ion concentration. Inhibition of methylation was observed even after prolonged acidification of sediments to pH 5.0 for up to 74 days. Acidification of sediments to pH 5.5, 4.5, and 3.5 with nitric acid resulted in a near-complete inhibition of methylation, indicating that the inhibition was due to the nitrate ion rather than to the acidity. Demethylation of methyl mercury was not affected by pHs between 8.0 and 4.4, but was sharply decreased below pH 4.4. Volatilization of Hg-203(++) from surface sediments was less than 2% of methylation activity and was not significantly different from that in killed sediments. The results indicated that acidification of sediments inhibits mercury methylation and that the observed increase in the mercury burdens in fish from low-pH lakes is not due to increased production of methylmercury in sediments. (Author's abstract)
W89-00731

EVALUATION OF THE SULFUR(IV) CATALYZED AUTOXIDATION OF COBALT(II) IN AN AZIDE CONTAINING MEDIUM AS A MEANS FOR THE DETERMINATION OF SULFITE IN PRECIPITATION,
Dortmund Univ. (Germany, F.R.). Fachbereich Chemie.
For primary bibliographic entry see Field 5A.
W89-00736

NITROGEN METABOLISM IN THE BRACKISH LAKE NAKANOUMI. III. NITRIFICATION-DENTRIFICATION IN LOW CONCENTRATION OF DISSOLVED OXYGEN, (IN JAPANESE),
Shimane Univ., Matsue (Japan). Faculty of Agriculture.
For primary bibliographic entry see Field 2H.
W89-00769

UTILIZATION OF NITROGENOUS NUTRIENTS BY NATURAL PHYTOPLANKTON IN ENRICHED LAKE WATERS,
Office of the Czechoslovak Federal Premier, Prague.
For primary bibliographic entry see Field 2H.
W89-00773

DISTRIBUTION OF CADMIUM IN LAKE TOHYA,
Hokkaido Univ., Hakodate (Japan). Faculty of Fisheries.
For primary bibliographic entry see Field 2H.
W89-00774

OIL POLLUTION IN THE CROMARTY FIRTH AND INSHORE MORAY FIRTH,
Nature Conservancy Council, Edinburgh (Scotland).
A. S. MacLennan.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 91, p 275-282, 1986. 2 fig, 2 tab, 7 ref.

Descriptors: *Moray Firth, *Water pollution sources, *Path of pollutants, *Scotland, *Water pollution effects, *Oil pollution, Spatial distribution, Environmental effects, Ecological effects, Estuaries, Rivers, North Sea, Birds.

Oil pollution incidents in the inshore Moray Firth (1975-84) and Cromarty Firth (1970-84), are reviewed, describing the levels, geographical patterns, trends and some impacts. Growth in oil-related activity in the inshore Moray and Cromarty Firths has not led to increased levels of oil pollution. In the Cromarty Firth the majority of incidents since 1970 have been from long-established shore-based sources, while the frequency of incidents and their impact have diminished over the last few years from levels in the early-mid 1970s. Incident levels in the inshore Moray Firth have also reduced since 1980. While no major environmental damage has resulted from oil pollution in this area, important wildlife resources, and in particular bird populations, have been shown in individual incidents to be extremely vulnerable to relatively small quantities of oil. It is important that continued attention is given to the prevention and treatment of oil pollution in this area and the strict procedures pertaining to oil exploration and production and operation of marine traffic should be maintained. (See also W89-00775) (Author's abstract)
W89-00785

MONITORING THE MORAY FIRTH ENVIRONMENT,
Marine Lab., Aberdeen (Scotland).
For primary bibliographic entry see Field 5C.
W89-00787

WATER QUALITY IN THE INVERNESS AND BEAULY FIRTHS,
Highland River Purification Board, Dingwall (Scotland).
J. Hunter, and D. Rendall.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 91, p 315-327, 1986. 9 fig, 4 tab, 21 ref.

Descriptors: *Beauly Firth, *Outfall sewers, *Tidal currents, *Coastal waters, *Water pollution sources, *Scotland, *Path of pollutants, *Water quality control, Estuaries, Rivers, Langman Bay, Ness Estuary, Inverness, Unit hydrographs, Water pollution control.

The Highland River Purification Board (Scotland) is carrying out a detailed study of the effect of Inverness sewage on the Beauly and Inverness Firths to ascertain the present degree of pollution and the best location for a new outfall. Hydrographic studies near the Inverness outfall, flood tide dragues releases, ebb tide drogue releases, ammonia and phosphorus levels in inshore and coastal water, methods used in water quality surveys, and hydrographic studies in the River Ness Estuary are discussed. The offshore water along the Beauly and Inverness Firths appears to be of good quality, but there is moderate pollution at Longman Bay. The shore between the Ness Estuary and Longman Point is very polluted and, at least in summer, sewage enters the Ness Estuary where the deeper waters become moderately polluted. When river flow is high it plays an important role in taking sewage seaward and protecting the Beauly Firth. (See also W89-00775) (Alexander-PTT)
W89-00789

HYDROCARBONS IN NIGG BAY SEDIMENTS,
M-Scan Ltd., Ascot (England).
P. J. C. Tibbets.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 91, p 329-339, 1986. 7 fig, 25 ref.

Descriptors: *Oil pollution, *Scotland, *Nigg Bay, *Moray Firth, *Sediments, *Water pollution sources, *Hydrocarbons, *Path of pollutants, Pollutant identification, Chromatography, Chemical analysis, Analytical methods, Spectroscopy, Spectrophotometry, Estuaries, Rivers, Beatrice oilfield, Estuarine sedimens, Mud flats, Estuarine sediments.

As part of the Moray Firth (Scotland) environmental monitoring program, Britoil commissioned a series of studies on the mudflats in Nigg Bay commencing in 1981. These cover an area of about five square miles and are situated in the Cromarty Firth adjacent to the oil terminal that handles crude oil from the Beatrice Field. Capillary gas liquid chromatography (GLC) analysis of the mudflat sediments in 1981 and 1982 showed a major autochthonous input of algal hydrocarbons as indicated by high n-C17 and C17 alkene concentrations. In addition there were low levels of petrogenic contamination, with concentrations of unresolved complex mixture (UCM), in general, being less than 10 ppm. These concentrations altered little between the two surveys during which time effluent discharge commenced from the oil terminal. In many of the GLC traces the dominant feature was an homologous series of n-alkanes in a smooth envelope from n-C22 to n-C34 with a maximum concentration at n-C25. This unusual distribution of n-alkanes does not appear to be associated with the UCM seen in many samples and may therefore not be of petrogenic origin. Possible sources of these components include bacteria and the erosion of local organic-rich shales, a selection of which have been sampled and analyzed. Gas chromatography mass spectrometry (GLC/MS) has been used in attempt to further clarify the origin of these n-alkanes. (See also W89-00775) (Author's abstract)
W89-00790

HYDROCARBON AND POLLUTANT LEVELS IN THE CROMARTY FIRTH,
Highland River Purification Board, Dingwall (Scotland).
J. S. Brown.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 91, p 341-347, 1986. 3 fig, 4 tab, 8 ref.

Descriptors: *Scotland, *Organic wastes, *Cromarty Firth, *Marine sediments, *Water pollution sources, *Path of pollutants, Hydrocarbons, Polychlorinated biphenyls, Pollution load, Estuaries, Rivers, Sediments, Scotland, Baseline studies, Industrial wastes, Domestic wastes, Fate of pollutants, Spatial distribution.

Data on hydrocarbon levels in sediments and waters of the Cromarty Firth are presented for samples collected during the period 1979-81. Use of this data as a baseline for subsequent studies on hydrocarbon levels in the firth is discussed. Data are presented on organic pollution of the firth by industrial and domestic wastes and on a chronic pollution incident involving polychlorinated biphenyls. In general, hydrocarbon levels are low and have remained low with increasing industrial expansion on the shores of the firth. Organic pollution is localized but significant. Pollution from polychlorinated biphenyls appears to be diminishing but requires further investigation. (See also W89-00775) (Author's abstract)
W89-00791

DEGRADATION OF LOW-TOXICITY OIL-BASED DRILLING MUD IN BENTHIC SEDIMENTS AROUND THE BEATRICE OILFIELD,
M-Scan Ltd., Ascot (England).
P. J. C. Tibbets, and R. Large.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 91, p 349-356, 1986. 4 fig, 7 ref.

Descriptors: *Scotland, *Marine sediments, *Oil pollution, *Drilling fluids, *Beatrice oilfield, *Path of pollutants, *Fate of pollutants, *Biodegradation, Hydrocarbons, Chromatography, Chemical analysis, Spatial distribution, Estuaries, Rivers, Moray Firth.

Hydrocarbon analyses, using gas-liquid chromatography (GLC), were conducted on benthic sediments from around the Beatrice A platform (Moray Firth, Scotland) immediately after completion of the first well using low-toxicity oil-based drilling mud. These analyses, as expected, showed the major organic contaminant in the sediments to be fresh base oil from the drilling mud. It could be detected to a distance of 3 km from the platform in the direction of the prevailing currents. A year later, after the completion of five additional wells using low-toxicity oil-based mud, a repeat survey showed the drilling mud base-oil could be detected in similar concentrations (by gravimetry) over the same spatial area. GLC analysis, however, showed that the base-oil had been severely biodegraded at many stations. The degree to which the n-alkanes had been biodegraded varied considerably between stations but appeared to be related to the distance from the platform and/or the total concentration of oil in the sediments. This has resulted in a discrete ring around the platform within which there was a rapid (and in many cases complete) loss of n-alkanes through biodegradation. Possible reasons for this phenomenon are discussed. (See also W89-00775) (Author's abstract)
W89-00792

OTHER FORMS OF ENVIRONMENTAL POLLUTION,
Central Electricity Generating Board, Leatherhead (England). Central Electricity Research Labs.
P. F. Chester.
Proceedings of the Royal Society of Edinburgh (Section B),Vol. 92 (Section B), p 127-137, 1987. 13 fig, 9 ref.

Descriptors: *Greenhouse effect, *Fuel, *Oxides, *Water pollution sources, *Path of pollutants, *Air pollution effects, *Climatology, *Acid rain, Sulfur compounds, Toxicity, Ozone, Carbon dioxide, Nitrogen oxides, Temperature, Hydrocarbons.

This paper discusses the four main invisible products of fossil fuel combustion: carbon dioxide, sulfur dioxide, nitric oxide and unburned hydrocarbons. If carbon exchanges between atmosphere, ocean and biosphere remain at their recent levels, the CO2 concentration in the atmosphere is likely to double later next century, with a possible rise in global mean temperatures of around 2 C resulting in significant changes in regional climates. The consequences are uncertain, but with adequate research there should be time to develop the understanding necessary to guide future policies. Sulfur dioxide, acid rain, and photochemical oxidants are a more pressing problem. Knowledge here is more complete, but still subject to considerable uncertainties that have an important bearing on the extent and rate of response of affected areas to reduction in acid deposition. However, from the year 2000 onwards, with the replacement of existing plant with nuclear power or new sulfur-free coal-burning technology, United Kingdom sulfur emissions will continue to decline at about twice the pace of their previous rise. Nitrogen oxides contribute to rain acidity, may have direct toxic effects on plants and, when accompanied by hydrocarbons, can generate ozone, itself a damaging pollutant. The chemistry of ozone production is, however, complex, such that intuitive control policies could be counter-productive. (See also W89-00775) (Author's abstract)
W89-00794

TRACE METALS IN THE COMMON MUSSEL MYTILUS EDULIS (L.) IN THE CLYDE ESTUARY,
Clyde River Purification Board, East Kilbride (Scotland).
B. S. Miller.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 90, p 377-391, 1986. 1 fig, 5 tab, 78 ref.

Descriptors: *Scotland, *Mussels, *Clyde Estuary, *Firth of Clyde, *Heavy metals, *Bioaccumulation, *Bioindicators, Spatial distribution, Toxicity, Chlorinated hydrocarbons, Polychlorinated biphenyls, Estuaries, Cadmium, Chromium, Lead, Path of pollutants, Coastal waters.

The Clyde River Purification Board (CRPB) initiated in 1980 an extensive 'mussel-watch' program, having selected the common mussel as the most suitable indicator organism. The 1984 CRPB 'mussel-watch' survey involved the collection of over 1200 mussels at twenty-four sites throughout the Firth of Clyde, with subsequent determination of concentrations of the trace metals Cd, Cr, Cu, Hg, Mn, Ni, Pb and Zn, and of other toxic, persistent substances such as organochlorine pesticides and PCB residues. The survey showed that trace metal body burdens are elevated at certain Clyde Estuary sites, due principally to the influence of local inputs or exposure to waters containing elevated bulk pollution loads. For the period 1980-1984, a statistical analyses of mean metal levels (for cadmium, chromium, and lead) at six sites sampled each year shows a significant change only for lead, upwards between 1982 and 1983. This change may be related to sediment load concentrations. A significant trend was found only for cadmium at two sites, negatively at Portkil Bayand positively at Dunoon. There was little inter-site uniformity of trend size or direction of each element studied. (Alexander-PTT)
W89-00823

CLEAN AIR ACT-TRANSBOUNDARY ACID RAIN POLLUTION ABATEMENT-ADMINISTRATIVE DISCRETION CITIZEN SUIT,
For primary bibliographic entry see Field 5G.
W89-00839

EFFECTS OF SULPHUR DEPOSITION ON LAKE-WATER CHEMISTRY IN ONTARIO, CANADA,
Ontario Ministry of the Environment, Dorchester. Dorset Research Center.
B. P. Neary, and P. J. Dillon.
Nature NATUAS, Vol. 333, No. 6171, p 340-343, May 1988. 3 fig, 1 tab, 21 ref.

Descriptors: *Water pollution sources, *Acid rain, *Air pollution effects, *Precipitation scavenging, *Sulfur compounds, Regional analysis, Chemical analysis, Water chemistry, Hydrogen ion concentration, Lakes, Acidification, Sulfates, Organic acids.

Clear links between regional lake acidification and the deposition of strong acids from the atmosphere have not been reported for North America. This is unlike the situation in Scandanavia, where acidification of lakes on a regional basis corresponds closely with the sulfur deposition pattern. Sulfur deposition in Ontario, Canada, decreases from south to north, with localized high deposition rates found in the Sudbury region. The chemical attributes of 1,168 lakes in different sulfur deposition zones defined by increments of 0.25 g/sq m/yr were compared. As sulfur deposition increased, lake SO4(2-) concentration increased, and alkalinity concentration and pH decreased. Increasing importance of organic acids did not result in lower alkalinity or pH. In the zones with sulfur deposition > 1.0 g/sq m/yr, almost one quarter of the lakes had pH values that would be expected to result in adverse biological effects. (Author's abstract)
W89-00846

DIFFERENCES IN THE SPECTRAL CHARACTERISTICS OF BIRCH CANOPIES EXPOSED TO SIMULATED ACID RAIN,
Institute of Terrestrial Ecology, Bangor (Wales). Bangor Research Station.
For primary bibliographic entry see Field 5C.
W89-00849

POLLUTION BENEATH THE GOLDEN GATE,
For primary bibliographic entry see Field 5C.
W89-00852

STATISTICAL METHODS AND SAMPLING DESIGN FOR ESTIMATING STEP TRENDS IN SURFACE-WATER QUALITY,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 7A.
W89-00862

MULTIVARIATE NONPARAMETRIC TESTS FOR TREND IN WATER QUALITY,
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7C.
W89-00863

PARAMETRIC AND NONPARAMETRIC TESTS FOR DEPENDENT DATA,
National Water Research Inst., Burlington (Ontario).
For primary bibliographic entry see Field 7C.
W89-00864

TAU-LIKE TEST FOR TREND IN THE PRESENCE OF MULTIPLE CENSORING POINTS,
Washington Univ., Seattle. Dept. of Biostatistics.
For primary bibliographic entry see Field 7C.
W89-00865

DATA ANALYSIS OF WATER QUALITY TIME SERIES IN LAKE ERIE,
Waterloo Univ. (Ontario). Dept. of Systems Design Engineering.
For primary bibliographic entry see Field 7C.
W89-00866

NONPARAMETRIC TESTS FOR TREND DETECTION IN WATER QUALITY TIME SERIES,
Quebec Ministere de l'Environnement, Sainte-Foy. Direction de la Qualite du Milieu Aquatique.
For primary bibliographic entry see Field 7C.
W89-00867

TRENDS IN LEAD CONCENTRATIONS IN MAJOR U.S. RIVERS AND THEIR RELATION TO HISTORICAL CHANGES IN GASOLINE-LEAD CONSUMPTION,
Geological Survey, Reston, VA.
R. B. Alexander, and R. A. Smith.
Water Resources Bulletin WARBAQ, Vol. 24, No. 3, p 557-569, June 1988. 9 fig, 4 tab, 35 ref.

Descriptors: *Data interpretation, *Statistical analysis, *Trend analysis, *Lead, *Stream pollution, *Gasoline, Path of pollutants, Heavy metals, Temporal distribution, Water quality, Nonparametric tests, Rivers.

Declines in concentrations of dissolved lead occurred at nearly two-thirds of 306 locations on major U.S. rivers from 1974 to 1985. Declines in dissolved lead concentrations are statistically significant ($p < 0.10$) at approximately one-third of the sampling locations. Statistically significant increases in dissolved lead concentrations occurred at only 6 percent of the sites, but are clustered in the Texas-Gulf and Lower Mississippi regions. Possible explanations for the observed trends in lead concentrations are tested through comparisons with (1) records of lead discharges from major sources including leaded-gasoline consumption and municipal- and industrial-point source discharges, (2) trends in various water-quality constituents such as pH and total alkalinity, and (3) basin characteristics such as drainage area. Statistically significant declines in lead concentrations in streams and gasoline lead (i.e., the largest source of lead at these sites) are highly coincident for the 1979 to 1985. No more than 5 percent of the trends in steam lead are influenced by municipal- and industrial-point sources of lead. Factors that affect the transport of dissolved lead, including lead solubility, suspended sediment, and basin characteristics such as drainage basin size, are not significantly related to trends in dissolved lead. Trends in streamflow explain no more than 7 percent of the downtrends in concentrations of lead and may partly explain the frequent increases in lead concentrations in the Texas-Gulf and Lower Mississippi regions. (See also W89-00861) (Author's abstract)
W89-00868

RECENT TRANSPORT OF METALS IN THE RIVER SEVERN AS RECORDED BY THE SEDIMENTS OF CHELMARSH RESERVOIR, SHROPSHIRE, U.K.,
Exeter Univ. (England). Dept. of Geography.
S. B. Bradley.
Journal of Environmental Science and Health JESEDU, Vol. A23, No. 5, p 425-440, 1988. 7 fig, 1 tab, 28 ref.

Descriptors: *Sediment transport, *Heavy metals, *Rivers, *River Severn, *Fluvial sediments, *England, Lead, Zinc, Copper, Cadmium, Manganese, Baseline studies.

Sediments from a reservoir on the bank of the River Severn show the content of Pb, Zn, Cu, Cd, and Mn transported with sediments in the river back to 1965 when the reservoir was commissioned. The River Severn is unpolluted as shown by the low levels of metals present in the sediment core; the most recent sediments show a decline in metal content. The chemical partitioning of metals is typical of fluvial sediments. Up to 68% of the Cd was exchangeable, while most of the Cu was present as an organic complex. The lead was in both the organic and residual fractions, and the Zn was in the Fe/Mn oxides and the residual fraction. These data on metal levels and on their chemical forms provide useful reference levels for sediments from polluted rivers. (Author's abstract)
W89-00885

MICROBIAL POLLUTION OF WELL WATER IN SOUTHEASTERN MINNESOTA,
Minnesota Univ., St. Paul. Coll. of Veterinary Medicine.
D. Amundson, C. Lindholm, S. M. Goyla, and R. A. Robinson.
Journal of Environmental Science and Health (A) JESEDU, Vol. 23, No. 5, p 453-468, 1988. 3 tab, 20 ref.

Descriptors: *Groundwater pollution, *Well water, *Microbiological studies, *Minnesota, *Pollutant identification, Coliforms, Well data, Karst hydrology, Bacterial analysis, Bacteriophage.

Southeastern Minnesota is characterized by karst topography which is responsible for the formation of sinkholes, subsurface cracks, and underground rivers. These features enhance transportation of surface contaminants into groundwater. The present study was conducted to determine the presence of coliforms, fecal coliforms and coliphages in private rural wells situated in this region. Another purpose was to study the occurrence of drug resistance in bacteria isolated from the groundwater. Well water from 18 sites was tested monthly for a period of 16 months. Seventeen of 18 sites sampled showed detectable levels of indicator bacteria. A total of 161 samples were tested for the presence of coliphages. Of these, 13 samples from 7 sites were found positive. On two occasions, coliphages were isolated from samples in which coliforms were undetectable. Water from 10 sites yielded drug resistant indicator bacteria. Twenty-five of 38 (65.8%) total coliforms and 9 of 27 (33.3%) fecal coliforms tested were found to carry drug resistance. (Author's abstract)
W89-00887

BASIC ENCODED MODEL FOR ONE-DIMENSIONAL GROUND WATER SYSTEMS INCORPORATING FIRST-ORDER DEGRADATION KINETICS,
Cook Coll., New Brunswick, NJ. Dept. of Environmental Science.
C. G. Uchrin, and T. E. Lewis.
Journal of Environmental Science and Health (A) JESEDU, Vol. 23, No. 5, p 469-482, 1988. 2 fig, 1 tab, 10 ref, append.

Descriptors: *Computer models, *Mathematical models, *Degradation, *Path of pollutants, *Computer programs, *Kinetics, *Groundwater pollution, Soil columns, Porous media, Contamination.

Prediction of the transport and ultimate fate of trace contaminants in ground water systems can be conservatively performed by treating the substance as non-reactive and non-adsorbing. The behavior of certain trace organic substances in two-phased systems consisting of a solute (water) and solids is complex because these substances have a tendency to adsorb onto the particulates. In addition, certain microbial populations present in soils and aquifers may metabolize partially or completely certain substances. Both a degradation term and a term describing the sorption processes must be incorporated into the mass balance modeling equation. A user-friendly BASIC computer program is presented for a one-dimensional mathematical model of contaminant transport in a porous medium employing linear, reversible, equilibrium partitioning for the adsorption/desorption mechanism and a first-order degradation kinetic mechanism. The model predicts the transient response of changeable contaminant step function inputs to a flow-through, porous-medium system. The program listing is supplied in an appendix. (Author's abstract)
W89-00888

ACIDIFICATION OF SHALLOW GROUNDWATERS DURING THE SPRING MELT PERIOD,
National Hydrology Research Inst., Saskatoon (Saskatchwan). Ground Water Div.
D. Craig, and L. M. Johnston.
Nordic Hydrology NOHYBB, Vol. 19, No. 2, p 89-98, 1988. 5 fig, 17 ref.

Descriptors: *Water pollution sources, *Surface-groundwater relations, *Groundwater pollution, *Groundwater recharge, *Acid rain, *Snowmelt, Silicates, Carbonate rocks, Hydrogen ion concentration, Canada, Acidic water.

During the spring of 1985 shallow recharge area groundwaters at depths less than one meter in the Turkey Lakes watershed, Ontario were observed to undergo short term (1 to 10 days) pH and alkalinity depressions associated with both rain and snow melt events. At the same time the concentrations of K(+) in the groundwater increased. Observations suggest that, if, during an individual loading event, the loading rate of hydrogen ions (H(+)) exceeds the rate at which alkalinity is made available through carbonate weathering reactions, increased aluminosilicate alteration can occur. Thus alumino silicate alteration may occur in groundwater systems with measurable carbonate alkalinity. (Author's abstract)
W89-00893

MODELLING THE EFFECTS OF ACID DEPOSITION: ESTIMATION OF LONG-TERM WATER QUALITY RESPONSES IN FORESTED CATCHMENTS IN FINLAND,
National Board of Waters, Helsinki (Finland). Water Research Inst.
A. Lepisto, P. G. Whitehead, C. Neal, and B. J. Cosby.
Nordic Hydrology NOHYBE, Vol. 19, No. 2, p 99-120, 1988. 6 fig, 9 tab, 38 ref.

Descriptors: *Model studies, *Mathematical models, *Water pollution sources, *Acid rain, *Forest watersheds, *Finland, Forecasting, Water quality, Chemical reactions, Humic acid, Hydrogen ion concentration, Surface water.

A modeling study was undertaken to investigate long-term changes in surface water quality in two contrasting forested catchments: Yli-Knuutila, with high concentrations of base cations and sulfate, in southern Finland; and organically rich, acid Liuhapuro in eastern Finland. The MAGIC model is based on the assumption that certain chemical processes (anion retention, cation exchange, primary mineral weathering, aluminum dissolution and CO2 solubility) in catchment soils are likely keys to the responses of surface water quality to acidic deposition. The model was applied for the first time to an organically rich catchment with high quantities of humic substances. The historical reconstruction of water quality at Yli-Knuutila indicates that the catchment surface waters have lost about 90 microequivalents/L of alkalinity in 140 years, which is about 60% of their preacidification alkalinity. The model reproduces the declining pH levels of recent decades as indicated by paleoecological analysis. Stream acidity trends were investigated assuming two scenarios for future deposition. Assuming deposition rates are maintained in the future at 1984 levels, the model indicated that stream pH is likely to continue to decline below presently measured levels. A 50% reduction in deposition rates would likely result in an increase in pH and alkalinity of the stream, although not to estimated preacidification levels. Because of the high load of organic acids to the Liuhapuro stream it had been acid before atmospheric pollution; a decline of 0.2 pH-units was estimated with increasing leaching of base cations from the soil despite the partial pH buffering of the system by organic compounds. (Author's abstract)
W89-00894

GROUNDWATER VELOCITY MAGNITUDE IN RADIONUCLIDE TRANSPORT CALCULATIONS,
D. J. Goode.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 114, No. 8, p 933-939, August 1988. 2 fig, 2 tab, 8 ref.

Descriptors: *Radioactive waste disposal, *Groundwater pollution, *Mathematical models, *Groundwater movement, *Path of pollutants, Mathematical analysis.

The Nuclear Regulatory Commission assesses potential doses resulting from the disposal of very slightly contaminated material in the ground using analytical solutions for one- and two-dimensional groundwater transport. A method was developed for determining a 'worst-case' groundwater velocity value for two conceptual models of decaying radionuclide transport, resulting in maximum calculated point concentration (MPCV). The MPCV is a function of the distance from the source, the radioactive decay rate, the retardation coefficient, and the longitudinal dispersivity. For the two-dimensional advection-dispersion model considered, the MPCV can be determined by a simple approximation multiplied by a given ratio. For many cases, the MPCV for a simple one-dimensional advection model may provide a reasonable estimate of the MPCV for more complex models which can be verified by computing concentrations corresponding to higher and lower velocity values. This method is only appropriate when no site-specific information on groundwater velocity is available. (VerNooy-PTT)
W89-00903

INTERACTIONS BETWEEN GROUNDWATER SEEPAGE AND SEDIMENT POREWATER SULPHATE CONCENTRATION PROFILES IN LAKE ANNA, VIRGINIA,

Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
P. E. McIntire, A. L. Mills, and G. M. Hornberger.

Hydrological Processes HYPRE3, Vol. 2, No. 3, p 207-219, July-September 1988. 7 tab, 1 fig, 21 ref.

Descriptors: *Diagenesis, *Path of pollutants, *Sulfates, *Lake Anna, *Lake sediments, Interstitial water, Virginia, Seepage, Vertical distribution, Groundwater, Acid mine drainage, Groundwater movement.

Most sulfur diagenesis models predict that SO4(--) concentrations decrease exponentially with increasing sediment depth and are lower than that of the overlying water throughout the sediments. Low SO4(--) concentrations (less than 0.2 mM) are common in the sediments of Lake Anna that receive acid mine drainage; however, sediment with as much as 20 mM SO4(--) at about 20 cm below the sediment surface is also seen in this section of the lake. A decision tree was proposed to investigate the cause of the high SO4(--) concentrations at depth (HSD) in the sediment. The first possibility proposed was that an increase in the quantity of groundwater flowing through Lake Anna sediments may increase groundwater detection of SO4(--) or oxygen which would induce sulfide oxidation. This hypothesis was tested by measuring groundwater flow. HSD profiles were found in a discrete region of the lake; however, stations having these profiles did not have higher groundwater flow than other sites sampled. Alternate explanations for the HSD profiles were that the region in which they occurred had: (1) unusual sediment chemical compositions; (2) a different source of regional groundwater, or (3) a lateral intrusion of high SO4(--) groundwater. There were no differences in sulfide and organic matter concentrations between the two regions. The area which has HSD in the sediment covers a large area in the middle of the lake, so it is unlikely that it has a unique source of regional groundwater. The third alternative was supported by the fact that in all three sample years, HSD stations were located in the preimpoundment stream channel, which is a likely lateral flow path for groundwater containing high SO4(--) concentrations. (Author's abstract)
W89-00910

STREAM NITRATE LEVELS IN A SMALL CATCHMENT IN SOUTH WEST ENGLAND OVER A PERIOD OF 15 YEARS (1970 - 1985),

Oxford Univ. (England). Geography School.
T. P. Burt, B. P. Arkell, S. T. Trudgill, and D. E. Walling.

Hydrological Processes HYPRE3, Vol. 2, No. 3, p 267-284, July-September 1988. 7 fig, 6 tab, 27 ref. Natural Environmental Research Council Grant GR3/4865.

Descriptors: *Stream pollution, *Nitrates, *England, *Nonpoint pollutin sources, *Statistical analysis, Data collections, Seasonal variation, Path of pollutants, Drought, Catchment areas.

Stream nitrate levels in a small catchment of mixed land use (the Slapton Wood Catchment) have been studied since September 1970; a record of this length is possibly unique in the United Kingdom for such a small basin (94 ha). A sustained increase in nitrate concentration has been observed during the study period. In addition to this long-term trend, short-term changes in nitrate concentrations relate to stream discharge levels and to seasonal variations. Multivariate statistical analysis has been used to quantify these trends and to identify those factors controlling the production and loss of nitrate from the catchment system. The main period of nitrate removal occurs in winter when high concentrations coincide with the main period of throughflow generation. The influence of climatic variability is illustrated by reference to the 1975/76 drought and post-drought period. (Author's abstract)
W89-00915

RECREATION RESOURCE ALLOCATION MODEL FOR PUBLIC DRINKING RESERVOIRS,

Massachusetts Univ., Amherst. Dept. of Landscape Architecture.
For primary bibliographic entry see Field 6D.
W89-00921

USE OF TOTAL ORGANIC CARBON AS AN INDICATOR OF CONTAMINATION FROM AN OIL REFINERY, SOUTH-CENTRAL KANSAS,

Kansas State Geological Survey, Lawrence.
For primary bibliographic entry see Field 5A.
W89-00942

CONTAMINATION OF FARMSTEAD WELLS BY PESTICIDES, VOLATILE ORGANICS, AND INORGANIC CHEMICALS IN KANSAS,

Kansas State Univ., Manhattan. Dept. of Agricultural Engineering.
J. Steichen, J. Koelliker, D. Grosh, A. Heiman, and R. Yearout.

Ground Water Monitoring Review GWMRDU, Vol. 8, No. 3, p 153-160, Summer 1988. 6 fig, 3 tab, 15 ref.

Descriptors: *Nitrates, *Wells, *Groundwater pollution, *Water quality, *Pesticides, Pollutant identification, Regression models, Model studies, Kansas, Organic compounds, Inorganic compounds, Water pollution sources, Farms.

Concern about the public health consequences of possible contamination of farmstead wells led to a random statewide survey in Kansas. The objective of the research was to conduct a random survey to determine the degree and extent of contamination of drinking water by pesticides, volatile organics, heavy metals, and other organic compounds. Results of the analyses showed that 8% of tested wells had detectable amounts of pesticides, 2% had detectable amounts of volatile organic chemicals, and 37% had some inorganic contaminant exceeding the maximum contamination level. Nitrate was the most common source of inorganic contamination, exceeding the maximum contamination level in 28% of the wells. Selenium levels exceeded the maximum contamination level in 9% of the wells. A multiple regression model for nitrate-N was developed. The factors included the age of the well, land use around the well, and the distance to the closest possible source of organic contamination. (Miller-PTT)
W89-00946

PROBLEM WITH NITRATES,

S. Hurlburt.

Water Well Journal WWJOA9, Vol. 42, No. 8, p 37-42, August 1988.

Descriptors: *Water pollution sources, *Groundwater pollution, *Water pollution control, *Nitrates, *Agricultural chemicals, *Fertilizers, *Pesticides, Nitrogen compounds, Methemoglobinemia, Legislation, Wells, Water quality management.

Causes and solutions to the problem of groundwater contamination by nitrates throughout the country, particularly in agricultural areas, were investigated. Much of the attention concerning nitrates came from the incidents of infant methemoglobinemia but the cause of the illnesses was never proven to be a result of nitrate levels in water. There seems to be very little question that nitrogen fertilizers are the main contributors to nitrate contamination. But, outdated and faulty well construction along with improper siting for wells also contributes to nitrate contamination. All indications are that there is a definite increase in contamination throughout the whole agricultural region. With increasing concern over nitrates, pesticides and the quality of groundwater, legislation addressing these issues is increasing. Not only to protect groundwater, but to reverse the effects of decades of fertilization and mismanagement, at least some regulation seems probable. (Miller-PTT)
W89-00965

CONTINUUM MODELS FOR CONTAMINANT TRANSPORT IN FRACTURED POROUS FORMATIONS,

Technion - Israel Inst. of Tech., Haita. Faculty of Civil Engineering.
B. Berkowitz, J. Bear, and C. Braester.

Water Resources Research WRERAO, Vol. 24, No. 8, p 1225-1236, August 1988. 6 fig, 1 tab, 35 ref.

Descriptors: *Groundwater movement, *Continuum models, *Path of pollutants, *Model studies, Porous media, Fracture permeability, Geologic fractures, Mathematical studies, Advection, Diffusion, Porosity, Pores, Capillary water.

This work examines some conditions under which contaminant transport in fractured porous rocks can be described by an equivalent porous medium (single continuum) model. For this purpose, a two-dimensional mathematical and numerical model for flow and contaminant transport was developed. The model allows for contaminant transport by advection, diffusion, and dispersion in both fractures and porous blocks. Concentration distributions were calculated for different flow conditions and medium properties. The resulting S-shaped breakthrough curves, characteristic of ordinary porous media, indicated the possibility of regarding the fractured porous medium as a single (equivalent) continuum. The results were compared to an existing analytical solution for contaminant movement in ordinary porous media. Analysis showed that within the range of considered parameter values, and except for the region close to the source, a single continuum model is sufficient for modelling the movement of contaminants. In such cases, application of the equivalent porous medium model in an actual field situation requires knowledge of the 'equivalent' porosity and the equivalent coefficient of dispersion appearing in the governing transport equation. In practice, these coefficients must be determined by analysis of breakthrough curves obtained from field tests. (Author's abstract)
W89-00966

NONAQUEOUS PHASE LIQUID TRANSPORT AND CLEANUP: I. ANALYSIS OF MECHANISMS,

California Univ., Berkeley. Dept. of Civil Engineering.
J. R. Hunt, N. Sitar, and K. S. Udell.

Water Resources Research WRERAO, Vol. 24, No. 8, p 1247-1258, August 1988. 7 fig, 1 tab, 69 ref. NSF Grant ECE 8352147.

Descriptors: *Water pollution treatment, *Water quality control, *Groundwater pollution, *Sorption, *Physical properties, *Cleanup operations, *Path of pollutants, Organic wastes, Porous media, Hydrocarbons, Hydraulic gradient, Leaks, Groundwater.

Groundwater contamination by nonaqueous liquids such as organic solvents and petroleum hydrocarbons frequently occurs as a result of surface spills, tank leaks, and improper disposal practices. This paper examines the physics governing the emplacement and movement of a separate phase in porous media, the role of sorption, and the conditions necessary to mobilize a separate phase. The movement of the separate phase is controlled by capillary forces, and ganglia displacement by groundwater is not possible under reasonable hydraulic gradients. In addition, because of mass transfer limitations in liquid phase dissolution, groundwater extraction at contaminated sites is shown to be ineffective in removing the nonaqueous contaminant within a reasonable time frame. Therefore, other means of mobilizing the trapped second phase are needed, steam displacement is proposed and steam front propagation through contaminated porous media is evaluated. (See also W89-00969) (Author's abstract)
W89-00968

NONAQUEOUS PHASE LIQUID TRANSPORT AND CLEANUP: II. EXPERIMENTAL STUDIES,

California Univ., Berkeley. Dept. of Civil Engineering.
J. R. Hunt, N. Sitar, and K. S. Udell.
Water Resources Research WRERAO, Vol. 24, No. 8, p 1259-1269, August 1988. 13 fig, 2 tab, 10 ref. NSF Grant ECE 8352147.

Descriptors: *Water pollution treatment, *Water quality control, *Steam displacement, *Groundwater, *Groundwater pollution, *Path of pollutants, *Cleanup operations, *Organic solvents, Organic wastes, Porous media, Groundwater flow, Experimental studies, Gasoline, Soil columns.

An analysis of the movement of nonaqueous liquids such as organic solvents and gasoline showed that separate phase liquids are not completely displaced by groundwater flow under typical pumping conditions and that removal of the compounds by dissolution is mass transfer limited. Steam displacement was proposed as a more efficient cleanup strategy for separate phase organic liquids present in porous media. This paper presents the results of a series of laboratory sand column studies. Experiments with trichloroethylene, a benzene-toluene mixture, and a commercial gasoline, showed that water flow at rates as high as 15 m/d could not displace the separate phase liquids when present in a sand matrix in quantities corresponding to a column average saturation of 2.5%. Steam injection, on the other hand, displaced the contaminants as a separate phase just ahead of the steam front, producing a concentrated, small-volume waste stream. Analysis of the laboratory data consisting of pressure gradients, temperature profiles, and water flow velocities shows that the laboratory results are consistent with the theoretical predictions. Moreover, computations of energy requirements show that steam displacement of separate phase contaminants is economically attractive. (See also W89-00968) (Author's abstract)
W89-00969

MULTISIGNAL AUTOMATIC CALIBRATION METHODOLOGY FOR HYDROCHEMICAL MODELS: A CASE STUDY OF THE BIRKENES MODEL,
Ontario Ministry of the Environment, Dorchester. Dorset Research Center.
E. de Grosbois, R. P. Hooper, and N. Christophersen.
Water Resources Research WRERAO, Vol. 24, No. 8, p 1299-1307, August 1988. 3 fig, 3 tab, 32 ref.

Descriptors: *Acid rain effects, *Geochemistry, *Birkenes models, *Chemical properties, *Model studies, Hydrographs, Hydrograph analysis, Mathematical studies, Calibrations, Optimization, Tracers, Hydrologic models, Model studies, Case studies, Path of pollutants.

Most hydrochemical models employ unmeasurable or 'artificial' parameters that need to be estimated from calibration data. A methodology is presented here for the automatic calibration of artificial parameters, which improves parameter identifiability through increasing the information available for determining the parameter values. Instead of calibrating the model using only one signal (e.g., the hydrograph), multiple signals (e.g., chemical signals as well as the hydrograph) are considered simultaneously. Either a simple least squares or a weighted least squares objective function may be used. The methodology is applied to the hydrologic module of the Birkenes hydrochemical model using artificial data. From a wide range of starting points, a gradient search optimization technique is able to consistently locate the correct parameter values uniformly better when using two signals (the hydrograph and a conservative tracer) than when only one signal (the hydrograph) is used. (See also W89-00974) (Author's abstract)
W89-00973

CONTINUUM APPROACH FOR MODELING MASS TRANSPORT IN FRACTURED MEDIA,
Alberta Univ., Edmonton. Dept. of Geology.
F. W. Schwartz, and L. Smith.
Water Resources Research WRERAO, Vol. 24, No. 8, p 1360-1372, August 1988. 11 fig, 4 tab, 10 ref.

Descriptors: *Continuum models, *Path of pollutants, *Model studies, *Geologic fractures, *Fracture permeability, *Groundwater movement, Capillary conductivity, Dispersion, Mathematical equations, Physical properties, Hydraulic gradient, Statistical analysis.

It involves a new application of a particle-tracking method in which physical transport is simulated in terms of velocity and the variations in velocity. Statistics describing the particle motion come from observing the actual pattern of particle motion in a discrete subdomain. This subdomain is a small but representative piece of the much larger continuum. In effect, particle motion in the continuum is forced to mimic that in the discrete subdomain. The model successfully duplicates patterns of anisotropic dispersion predicted by de Josselin de Jong and breakthrough curves simulated with a discrete fracture model. Applications demonstrate that the de Josselin de Jong approach for estimating dispersivities for idealized networks cannot generally be applied to networks formed from sets of finite, irregularly spaced fractures. In addition, this study reinforces indications from earlier studies about the complexity of dispersion in fractured media. Factors that contribute to spreading in the major and minor principal directions change with the orientation of the network relative to the mean hydraulic gradient. (Author's abstract)
W89-00980

NUMERICAL MODELING OF SORPTION KINETICS OF ORGANIC COMPOUNDS TO SOIL AND SEDIMENT PARTICLES,
National Taiwan Univ., Taipei. Inst. of Environmental Engieering.
S. Wu, and P. M. Gschwend.
Water Resources Research WRERAO, Vol. 24, No. 8, p 1373-1383, August 1988. 9 fig, 19 ref. EPA Contract CR 810472-01-0.

Descriptors: *Path of pollutants, *Fate of pollutants, *Model studies, *Mathematical models, *Kinetics, *Sorption, *Organic compounds, *Sediments, Diffusivity, Particle size, Particulate matter, Aggregates, Capillary water, Adsorption, Soil water, Groundwater.

A model was developed to simulate hydrophobic organic compound sorption, based on a retarded intraaggregate diffusion conceptualization of this solid-water exchange process. This model was used to ascertain the sensitivity of the sorption process for various sorbates to nonsteady solution concentrations and to polydisperse soil or sediment aggregate particle size distributions. Common approaches to modeling sorption kinetics amount to simplifications of our model and appear justified only when (1) the concentration fluctuations occur on a time scale that matches the sorption timescale of interest and (2) the particle size distribution is relatively narrow. Finally, a means is provided to estimate the extent of approach of a sorbing system to equilibrium as a function of aggregate size, chemical diffusivity and hydrophobicity, and system solids concentration. (Author's abstract)
W89-00981

CONTAMINANT TRANSPORT IN FRACTURED POROUS MEDIA: STEADY STATE SOLUTIONS BY A BOUNDARY INTEGRAL METHOD,
Melbourne Univ., Parkville (Australia). Dept. of Mathematics.
A. Fogden, K. A. Landman, and L. R. White.
Water Resources Research WRERAO, Vol. 24, No. 8, p 1384-1396, August 1988. 5 fig, 3 tab, 16 ref, append.

Descriptors: *Groundwater movement, *Numerical analysis, *Fate of pollutants, *Fracture permeability, *Porous media, *Path of pollutants, *Plumes, *Capillary conductivity, *Mathematical studies, Mathematical equations, Geologic fractures, Model studies, Advection, Diffusivity, Vertical flow.

The problem of steady state transport of a decaying contaminant in a fractured porous rock matrix by two-dimensional diffusion and vertical advection was solved using a powerful (and readily generalizable) numerical method. Worst case predictions of contaminant penetration were obtained by assuming that the uniform porous medium contains either a single vertical fracture or a periodic array of vertical fractures. The method requires construction of appropriate Green's functions, which were obtained analytically in both the fracture and matrix regions. Application of Green's theorem in the plane then yields representations for the contaminant concentration in both regions in terms of integrals along their boundaries of known quantities and the unknown fracture-matrix interfacial flux. This flux was given by a Fredholm integral equation which can be solved numerically to great accuracy using a simple discretization technique. At sufficiently large distances vertically from the source, the concentration was observed to be exponentially decaying. Although the concentration can, in general, only be obtained numerically, an analytical method was developed which produces a uniformly valid and extremely accurate approximation to its vertical decay length. Also, an assessment of the accuracy of analytical approximations made by Tang, Frind, and Sudicky and Sudicky and Frind to the solution of the full problem is provided. These simpler pseudo-two-dimensional models were found to be accurate approximations to the exact solution of the general 'full two-dimensional' problem, but cease to be valid in extreme cases. (Author's abstract)
W89-00982

THEORETICAL ANALYSIS OF DEVIATIONS FROM LOCAL EQUILIBRIUM DURING SORBING SOLUTE TRANSPORT THROUGH IDEALIZED STRATIFIED AQUIFERS,
Illinois Univ., Urbana. Dept. of Civil Engineering.
A. J. Valocchi.
Journal of Contaminant Hydrology, Vol. 2, No. 3, p 191-207, July 1988. 5 fig, 23 ref, append. NSF Grant ECE-8418644.

Descriptors: *Mathematical analysis, *Stratified aquifers, *Path of pollutants, *Sorption, *Solute transport, *Aquifers, *Aquifer characteristics, *Groundwater movement, *Adsorption, Permeability coefficient, Plumes, Kinetics, Equilibrium, Vertical flow, Infiltration, Stratification.

This paper describes a study of the spreading characteristics of reactive solute plumes in idealized stratified aquifers, consisting of two layers having different permeabilities with flow parallel to the stratification. The solute is assumed to adsorb onto the aquifer solids according to a first-order reversible kinetic rate law; the adsorption parameters are spatially uniform. The Aris moment method was used to examine analytically the time evolution of the lower-order spatial moments of the depth-averaged contaminant plume for an instantaneous input of mass. The results demonstrated that sorption kinetics cause the total dissolved mass and average velocity of the contaminant plume to decrease with increasing travel time. The plume variance was shown to depend upon three factors: intralayer longitudinal dispersion, intra-layer kinetics, and vertical averaging. The results indicate that the relative importance of sorption kinetics diminishes as the permeability contrast between the layers increases. A simple criterion is presented that can be used to assess the applicability of the local equilibrium assumption in idealized stratified systems. (Author's abstract)
W89-00987

SORPTION NONEQUILIBRIUM DURING SOLUTE TRANSPORT,
Robert S. Kerr Environmental Research Lab., Ada, OK.
D. C. Bouchard, A. L. Wood, M. L. Campbell, P. Nkedi-Kizza, and P. S. C. Rao.
Journal of Contaminant Hydrology, Vol. 2, No. 3, p 209-223, July 1988. 8 fig, 3 tab, 36 ref.

Descriptors: *Groundwater movement, *Path of pollutants, *Solute transport, *Sorption, Pore water, Porous media, Permeability coefficient, Or-

ganic compounds, Diffusivity, Adsorption, Soil water, Aquifers.

The effects of pore-water velocity, solute hydrophobicity, and sorbent organic-carbon content on sorption nonequilibrium during solute transport were evaluated. Nonequilibrium transport was observed to increase with pore-water velocity, solute hydrophobicity, and sorbent organic-carbon content. Nonequilibrium transport of neutral organic compounds was not detected with low organic-carbon (TOC = 0.33 g/kg aquifer material, but was detected on higher organic sorbents from the unsaturated zone (TOC = 2.6 g/kg) and the soil surface (TOC = 6.9 g/kg). For solute-sorbent combinations yielding retardation factors > 2, nonequilibrium during transport was observed. After experimentally accounting for slow solute diffusion in the aqueous phase and isotherm nonlinearity as potential contributors to nonequilibrium solute transport, sorption nonequilibrium was attributed to slow solute diffusion within the organic-carbon matrix. (Author's abstract)
W89-00988

SIMULATION MODEL FOR BIOTRANSFORMATION OF XENOBIOTICS AND CHEMOTAXIS IN SOIL COLUMNS,
Agricultural Univ., Wageningen (Netherlands). Dept. of Microbiology.
T. N. P. Bosma, J. L. Schnoor, G. Schraa, and A. J. B. Zehnder.
Journal of Contaminant Hydrology, Vol. 2, No. 3, p 225-236, July 1988. 3 fig, 4 tab, 34 ref.

Descriptors: *Biodegradation, *Simulation, *Model studies, *Soil chemistry, *Fate of pollutants, *Biotransformation, *Soil bacteria, Soil environment, Chemical properties, Kinetics.

In this paper a model is presented that can be used to simulate the behavior of xenobiotic chemicals in soil columns with respect to their physical and chemical properties. Terms describing biological transformation of xenobiotics are also included in the model. It incorporates microbial growth following Monod kinetics and a chemotactic response of the transforming bacteria towards the xenobiotic substrate. The model appeared to yield good simulations of an experiment that investigated the degradation of 1,2-dichlorobenzene in soil columns inoculated with Pseudomonas sp. strain P51. The behavior and the fate of 1,4-dichlorobenzene could be simulated using this model they were also adequately simulated using a simple second order model. The results generated by the model correspond to kinetic parameters obtained in other studies. It is concluded that the model is a useful tool for the investigation of the activity of bacteria degrading xenobiotics in soil columns, provided that the microbial parameters can be determined in independent experiments, and that the active microbial mass in the soil can be measured. (Author's abstract)
W89-00989

REACTOR ACCIDENT AT CHERNOBYL: A POSSIBILITY TO TEST COLLOID-CONTROLLED TRANSPORT OF RADIONUCLIDES IN A SHALLOW AQUIFER,
Bern Univ. (Switzerland). Radiochemisches Lab.
H. R. Von Gunten, U. E. Waber, and U. Kraehenbuehl.
Journal of Contaminant Hydrology, Vol. 2, No. 3, p 237-247, July 1988. 1 fig, 3 tab, 27 ref.

Descriptors: *Path of pollutants, *Radiochemical analysis, *Colloids, *Groundwater pollution, *Radioactive wastes, *Nuclear powerplants, Pollutant identification, Aquifers, Soviet Union, Groundwater, Groundwater management, Nuclear reactors, Particulate matter, Groundwater recharge, Geohydrology.

Radioactive fall-out from the damaged nuclear power station at Chernobyl (USSR) has been measured in May 1986 in the River Glatt (Zurich, Switzerland) and in a shallow groundwater stream. This aquifer is hydraulically connected to the river and recharged by river water. Ruthenium-103, I-131, Te-132, Cs-134 and Cs-137 were measured several times using gamma-ray spectroscopy. By filtration through 0.45 microns, 0.2 microns and 0.05 microns filters the radionuclides were partitioned between solution (filtrate < 0.05 microns) and particles/colloids. In the river, the main radioactivity for all the investigated nuclides was found in the water passing the 0.05 microns filter. Among the particulates the highest radioactivity was detected in the fraction > 0.45 microns, the two smaller sizes contributing only little. In the water infiltrating into the groundwater Ru-103, I-131 and Te-132 were found almost exclusively in the filtrate (< 0.05 microns). No Cs-134, 137 was detected in this fraction indicating complete sorption on the aquifer material during infiltration. Only a very small radioactivity was found on colloids > 0.05 microns suggesting that most was retained by the heterogeneous glaciofluvial outwash deposits (stones, gravel, sand, clays). (Author's abstract)
W89-00990

SORPTION AND DESORPTION DYNAMICS OF AROCLOR 1242 TO NATURAL SEDIMENT,
Princeton Univ., NJ. Dept. of Civil Engineering.
P. J. Witkowski, P. R. Jaffe, and A. Ferrara.
Journal of Contaminant Hydrology, Vol. 2, No. 3, p 249-269, July 1988. 9 fig, 3 tab, 50 ref.

Descriptors: *Polychorinated biphenyls, *Aroclors, *Sorption, *Path of pollutants, *Fate of pollutants, *Sediments, Model studies, Aquatic soils, Kinetics, Equilibrium, Adsorption, Organic coumpounds.

Sediment sorption and desorption processes are important in determining the movement and fate of persistent compounds in aquatic systems. Batch experiments show that after an initial one week uptake period, continual release of Aroclor 1242 from sediment occurs over a six-month period. These observations suggest that a two-stage kinetic model, rather than the conventional equilibrium model, is more appropriate for representing sediment uptake and release processes. Additional batch studies were used to measure short- and long-term rate coefficients for these processes. Simulation studies, with multiple sediment and contaminant inputs, indicate that over a 16-day period a kinetic model better matches the experimental data than do three other equilibrium-based sorption/desorption models. further long-term simulations demonstrate that the kinetic mode, rather than the equilibrium models, more adequately account for the persistence of organic contaminants in sediment. (Author's abstract)
W89-00991

STATISTICAL CORRELATIONS FOR PREDICTING THE PARTITION COEFFICIENT FOR NONPOLAR ORGANIC CONTAMINANTS BETWEEN AQUIFER ORGANIC CARBON AND WATER,
General Motors Research Labs., Warren, MI. Environmental Science Dept.
A. S. Abdul, T. L. Gibson, and D. N. Rai.
Hazardous Waste and Hazardous Materials HWHME2, Vol. 4, No. 3, p 211-222, Summer 1987. 5 fig, 1 tab, 16 ref.

Descriptors: *Correlation analysis, *Groundwater pollution, *Organic carbon, *Fate of pollutants, *Organic compounds, *Statistical analysis, *Path of pollutants, Adsorption, Solubility, Mathematical studies, Model studies, Aquifers, Adsorption.

The mobility of contaminants in an aquifer and the risks that they present the environment depend on the extent to which they can be adsorbed by the aquifer material. The purpose of this study was to evaluate whether adsorption of nonpolar organic contaminants can be estimated from measurements of the aquifer organic carbon (foc) and from the known octanol-water partition coefficients (Kow) or aqueous solubilities of the contaminants. The adsorption of eight nonpolar organic compounds (pyrene, benzene, toluene, m-xylene, o-xylene, p-xylene, trichloroethylene, and tetrachloroethylene) on subsamples of three aquifer materials was studied in batch equilibrium experiments. All adsorption isotherms were linear over a range of dilute equilibrium aqueous concentrations. The relationship between the slopes of the adsorption isotherms (Kd) of the eight organic compounds and the values of foc of the subsamples was also linear. In addition, linear log-log relationships were found between the slopes of the Kd versus foc relationships (Koc) and the Kow or aqueous solubilities of 13 nonpolar organic compounds, eight from this study and five from our previous studies. These log-log relationships appear to be general since they also adequately describe adsorption data in the literature for 20 additional organic compound/soil combinations. Thus, it appears that adsorption of nonpolar organic contaminants by aquifer materials can be correlated with either the octanol-water partition coefficients or with the aqueous solubilities of these contaminants. These correlations can be used in estimating the extent to which adsorption would retard the movement of nonpolar organic contaminants through aquifers. (Author's abstract)
W89-00992

ESTIMATION OF THE RISK ASSOCIATED WITH THE ORGANIC CONSTITUENTS OF HAZARDOUS AND MUNICIPAL WASTE LANDFILL LEACHATES,
Texas A and M Univ., College Station. Dept. of Soil and Crop Sciences.
K. W. Brown, and K. C. Donnelly.
Hazardous Waste and Hazardous Materials HWHME2, Vol. 5, No. 1, p 1-30, Winter 1988. 10 tab, 72 ref.

Descriptors: *Garbage dumps, *Leachates, *Waste disposal, *Path of pollutants, *Groundwater pollution, *Hazardous materials, *Risks, *Landfills, Municipal wastes, Population exposure, Organic compounds, Toxicity, Carcinogens, Industrial waste, Groundwater, Human population, Environmental effects, Surface-groundwater relations.

Although restrictions on the landfilling of hazardous industrial wastes have greatly increased, most municipal wastes are still disposed of in soil lined pits that can readily leak contaminated leachates to the subsurface environment. Since municipal waste landfills are numerous and contain many of the same compounds as found in industrial wastes, it is essential to evaluate the risks to human health and the environment from exposure to ground water contaminated with municipal waste landfill leachate. This study was undertaken to compile chemical constituent and concentration data and, also, to estimate the risk that would be associated with exposure to the organic pollutants found in leachate from industrial and municipal waste landfills. Toxic and cancer causing chemicals were found in the leachates from all 58 landfills for which data were available irrespective of the type of waste that they received. Although different groups of pollutants are found in the different landfills, the concentrations and toxicity are such that the leachate from some municipal waste landfills may cause as great a cancer risk as those from industrial waste landfills. The risk calculations based on suspect carcinogens only indicate that the estimated carcinogenic potency for the leachate from some municipal landfills may be similar to the carcinogenic potency for the leachate from the Love Canal landfill. (Author's abstract)
W89-00995

DESIGN CRITERIA FOR IN-SITU AND ON-SITE RENOVATION OF AN INDUSTRIAL SLUDGE LAGOON,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Chemical and Biochemical Engineering.
D. S. Kosson, and R. C. Ahlert.
Hazardous Waste and Hazardous Materials HWHME2, Vol. 5, No. 1, p 31-52, Winter 1988. 14 fig, 5 tab, 9 ref. EPA Grant CA-807805.

Descriptors: *Hazardous materials, *Waste disposal, *Cleanup operations, *Sludge disposal, *Sludge lagoons, *Remedies, Case histories, Design criteria, Secondary wastewater treatment, Biological wastewater treatment, Aerobic treatment.

The case history of design and implementation of a remediation strategy for a hazardous waste dispos-

al site is described. Over several decades, sludges from chemical manufacturing were disposed of in an unlined surface impoundment. The 4.1 acre site contains approximately 23,000 cu m of sludge. Laboratory experiments were conducted to evaluate forced extraction of the sludges, aerobic mixed microbial (secondary) treatment and soil-based microbial treatment of leachate and sludge extracts. Exhaustive extraction of TOC from the sludges, with dilute aqueous sodium hydroxide, was possible. Treatment of leachate and sludge extracts with a soil-based microbial treatment process achieved TOC reductions in excess of 95%. A pilot plant to demonstrate these processes for clean-up of the lagoon was designed, constructed and operated for 140 days. In-situ sludge extraction followed by on-site soil-based microbial treatment was employed. Results confirmed laboratory findings. Design criteria for the full-scale renovation of the lagoon have been developed. Preliminary design estimates indicate that complete lagoon renovation will require about five years of process operation at a total cost of approximately $3,000,000. (Author's abstract)
W89-00996

TERRESTRIAL BIOACCUMULATION POTENTIAL OF PHENOLIC COMPOUNDS,
Texas Univ. at Austin. Dept. of Civil Engineering.
R. C. Loehr, and R. Krishnamoorthy.
Hazardous Waste and Hazardous Materials HWHME2, Vol. 5, No. 2, p 109-119, Spring 1988. 1 fig, 6 tab, 22 ref. EPA Grant CR-812819.

Descriptors: *Bioaccumulation, *Biological magnification, *Water pollution effects, *Fish populations, *Phenols, Chemical properties, Aquatic animals, Fish toxins, Population exposure, Partition coefficients, Comparison studies, Hydrocarbons, Tissue analysis, Chlorinated hydrocarbons, Path of pollutants.

An assessment of terrestrial bioaccumulation was made for phenol and chlorophenols using literature information. Most of the available data for the chemicals related to their aquatic bioaccumulation potential and both terrestrial and aquatic data were used for the assessment. Of the phenolic compounds evaluated, quantitative fish bioconcentration data (BCF) were available only for 13. The evaluation indicated that: (a) the BCF value for a specific chemical depended on the type of fish being evaluated, varying by about three orders of magnitude for some chemicals, and (b) for most fish types, the BCF values were correlated positively to the octanol water partition coefficient (Kow) and were negatively correlated with aqueous solubility. Based on interpretation of the available information, subjective judgments of the bioaccumulation potential of the designated chemicals were made. Eleven of these chemicals may bioaccumulate in terrestrial or aquatic organisms. These were judged to be: 2-chlorphenol, 4-chlorophenol, 2,4,5-trichlorphenol, 2,4,6-trichlorophenol, 2,3,4,6-tetrachlorphenol, pentachlorophenol, p-nitrophenol, 4,6-dinitro-o-cresol, p-chloro-m-cresol, and 2,4-demethylphenol. The logic for these judgments is presented. Such subjective judgments do not take the place of actual data but they can provide a guide to identify which chemicals may bioaccumulated. (Author's abstract)
W89-00998

LEACHING OF INORGANIC HAZARDOUS CONSTITUENTS FROM STABILIZED/SOLIDIFIED HAZARDOUS WASTES,
Cincinnati Univ., OH. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5E.
W89-00999

EROSION AND SEDIMENT YIELD RESEARCH: SOME RECENT PERSPECTIVES,
Exeter Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 2J.
W89-01015

GROUNDWATER FLOW AND TRANSPORT MODELING,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2F.
W89-01025

TRANSPORT OF SOLUTES IN SOILS AND AQUIFERS,
Agricultural Univ., Wageningen (Netherlands). Dept. of Land and Water Use.
W. H. Van der Molen, and H. C. Van Ommen.
Journal of Hydrology JHYDA7, Vol. 100, No. 1/3, p 433-451, July 30, 1988. 5 fig, 75 ref.

Descriptors: *Path of pollutants, *Solute transport, *Literature reviews, *Groundwater pollution, *Soil contamination, Aquifers, Groundwater movement, Spatial variation, Diffusion, Dispersion, Displacement, Density currents, Model studies, Mathematical models, Saline water intrusion.

Mechanisms involved in solute transport in soils and aquifers are displacement, diffusion, dispersion, density currents, and spatial variability. Methods for describing transport processes by these mechanisms are also discussed. (1) Displacement of one type of soil moisture or groundwater with another (natural with polluted) can be studied by sampling, simple transport models, velocity vector integration, two-dimensional flow patterns for movement, and tracer studies. (2) Diffusion of solutes (e.g., salt) can be modeled by numerical procedures, such as the random walk method, and methods used to describe heat flow. (3) Dispersion is modeled with the Zuur-Verhoeven method, but the deeper layers shows a complicated behavior. The theory of chromatography provides an adequate model for this process. (4) Spatial variability is great even in soils and aquifers that appear homogeneous. Flow through cracks is found in salty lands, heavy soils, and under irrigation and ponding. This necessitates revision of the dispersion theory. Bypass flow concentrates solutes at the phreatic level, where degradation is inhibited. (5) Density currents may impede or promote groundwater flow. Mixing is not extensive in coastal areas where fresh water overlies saline groundwater. However, sea water above fresh water rapidly mix in thick aquifers of high permeability under confined or semiconfined conditions with little vertical resistance. (Cassar-PTT)
W89-01027

CONTAMINANT HYDROGEOLOGY DOLLARS AND SENSE,
Alberta Univ., Edmonton. Dept. of Geology.
F. W. Schwartz.
Journal of Hydrology JHYDA7, Vol. 100, No. 1/3, p 453-470, July 30, 1988. 3 fig, 67 ref.

Descriptors: *Hydrology, *Geohydrology, *Path of pollutants, *Groundwater pollution, *Literature reviews, *Waste disposal, Radioactive waste disposal, *Landfills, Plumes, Solute transport, Geologic fractures, Love Canal, New York, Regulations, Boreholes.

Regulations designed to clean up hazardous waste sites and prevent future problems have stimulated the science and technology dealing with contamination of groundwater. The Love Canal problem received much publicity. Additional impetus has been provided by searches for nuclear waste depositories. Specific achievements in the practical aspects of groundwater contamination include methods for plume definition (improved sampling techniques and soil gas analysis); techniques for site remediation (pumping for removal of light, nonaqueous contaminants, in-situ volatilization, and enhanced bioreclamation); and measurements in deep boreholes drilled in low-permeability rocks. Theoretical developments are concerned with better understanding of old transport processes (dispersion) and new transport processes (diffusion into the matrix), verifying these theoretical ideas in field tests, and dealing with fractured rocks. Negative aspects of groundwater studies are difficulties in translating theory into practice, difficulties in technology transfer, and aimlessness of theoretical work. Future trends point toward a shift from computer-based theoretical work to field-based experimental work, a more systematic look at phenomena previously investigated, increased productivity through technological developments, and limitation of creativity by concentrating on projects most appealing to funding groups. (Cassar-PTT)
W89-01028

USE OF FACTORIAL EXPERIMENTAL DESIGN TO EVALUATE HOW BIOTIC AND ABIOTIC FACTORS INFLUENCE CADMIUM ACCUMULATION IN THE UNICELLULAR ALGA DUNALIELLA BIOCULATA,
Paris-7 Univ. (France). Lab. de Cytophysiologie Vegetale et Toxicologie Cellulaire.
E. Heuillet, A. Bermond, N. Jeanne, S. Puiseux-Dao, and C. Ducauze.
Marine Ecology Progress Series MESEDT, Vol. 44, No. 1, p 69-75, April 21, 1988. 1 fig, 6 tab, 39 ref.

Descriptors: *Cadmium, *Heavy metals, *Bioaccumulation, *Path of pollutants, *Toxicity, *Marine algae, Accumulation, Water pollution effects, Algae, Culturing techniques, Culture media, Growth, Calcium.

The influence of biotic and abiotic variables on the bioaccumulation of cadmium was evaluated using Dunaliella bioculata, a marine unicellular alga, as a model. Factorial experimental design and response-surface methodology were used to follow the variation of cadmium uptake caused by variations of the following variables: (1) cadmium concentration in the medium, (2) calcium concentration of culture medium, (3) duration of exposure during the period of light, (4) period of darkness, (5) the exponential phase, and (6) the stationary phase of the growth. This methodology proved to be very efficient, since only 8 experiments were necessary to follow the cadmium uptake for each condition. It is concluded that cadmium uptake increases with cadmium concentration in the medium and with exposure time, but that their effects are not simply additive. Cadmium uptake depends heavily on the calcium concentration in the medium. Different hypotheses for the cadmium absorption mechanism and for the physiological explanation of the Cd-Ca antagonism are discussed. (Author's abstract)
W89-01043

ORGANOCHLORINES AND EGGSHELL THINNING IN NORTHERN GANNETS (SULA BASSANUS) FROM EASTERN CANADA, 1968-1984,
National Wildlife Research Centre, Ottawa (Ontario).
For primary bibliographic entry see Field 5C.
W89-01054

ALUMINUM SPECIATION IN SURFACE WATERS FROM A WELSH UPLAND AREA,
University Coll. of Swansea (Wales). Dept. of Chemical Engineering.
X. Goenaga, and D. J. A. Williams.
Environmental Pollution ENPOEK, Vol. 52, No. 2, p 131-149, 1988. 5 fig, 3 tab, 29 ref.

Descriptors: *Acid rain effects, *Water pollution sources, *Aluminum, *Wales, *Chemical speciation, Surface waters, Catchment areas, Suspended solids, Hydrogen ion concentration, Acidic water, Metals, Reservoirs, Chemical analysis, Conductivity, Thermodynamics, Pollutants, Fluorides, Solubility, Water quality, Filtration.

The complete aluminum speciation of surface waters from an acidified catchment, during dry weather and during storm episodes, was obtained. For the first time, estimates of adsorbed aluminum are reported together with other aluminium species. Adsorbed aluminum was calculated from the difference between monomeric aluminium content before and after separation of suspended solids by filtration (0.015 micro m pore diameter). This fraction was very significant for samples with high suspended solids content collected during storm episodes. Plots of pAl(3+) versus pH for samples collected during dry weather are approximated by a straight line, close to the solubility line of synthetic gibbsite, and have a slope of 2.5, which

suggests that these samples were saturated with respect to gibbsite. The cloud of pAl(3+) versus pH points for samples from storm episodes has a near zero slope, and shows a significant degree of undersaturation with respect to synthetic gibbsite. Various mechanisms of aluminum mobilization are discussed. (Author's abstract)
W89-01055

VARIATIONS IN POLYCHLORINATED BIPHENYL CONGENER COMPOSITION IN EGGS OF MEDITERRANEAN WATER BIRDS IN RELATION TO THEIR POSITION IN THE FOOD CHAIN,
Siena Univ. (Italy). Dipt. di Biologia Ambientale.
S. Focardi, C. Leonzio, and C. Fossi.
Environmental Pollution ENPOEK, Vol. 52, No. 4, p 243-255, 1988. 5 fig, 6 tab, 24 ref.

Descriptors: *Path of pollutants, *Polychlorinated biphenyls, *Eggs, *Water birds, *Food chains, Ecology, Mediterranean, Standard deviation, Italy, Pollutants, Environmental effects, Water pollution sources, Toxicity, Chlorinated hydrocarbons.

The concentrations of the principal PCB congeners were determined in eggs of eight species of water birds collected in two areas of the Mediterranean region. The results for total PCB levels indicate statistically significant differences between the species; in the Po delta the higher values are for those species which feed mainly on fish. Differences exist between the congeners and their percentages when compared with the total residue. Tetrachlorobiphenyls constitute a larger proportion of the total PCB in Avocet and Black-winged Stilt, two species whose diet consists mainly of invertebrates. The main component in all the species is 22'44'55' and its presence varies between 11.4% in Avocet and 21.2% in Audouin's Gull. It is suggested that there is a link between the uptake of PCBs and the position of the species in the food chain. (Author's abstract)
W89-01056

EFFECTS OF A SIMULATED ACID PRECIPITATION ON LEAF LITTER QUALITY AND THE GROWTH OF A DETRITIVORE IN A BUFFERED LOTIC SYSTEM,
Calgary Univ. (Alberta). Aquatic Ecology Section.
For primary bibliographic entry see Field 5C.
W89-01058

UTILITY OF LABORATORY STREAMS FOR ECOSYSTEM TOXICITY STUDIES,
Oregon State Univ., Corvallis. Oak Creek Lab. of Biology.
M. J. Wevers, W. J. Liss, and C. E. Warren.
Environmental Management EMNGDC, Vol. 12, No. 1, p 19-27, 1988. 2 fig, 36 ref.

Descriptors: *Path of pollutants, *Water pollution effects, *Streams, *Toxicity, *Laboratories, *Fate of pollutants, Ecosystems, Model studies.

Laboratory stream microcosms have been used to study transport, fate, and effects of toxic substances in stream ecosystems. Several general concerns exist in utilizing laboratory streams in this way. Some of the most important and difficult of these problems are summarized. Approaches necessary for making laboratory stream ecosystem studies more useful in solving problems of toxic substance behavior in natural ecosystems is provided. Well designed laboratory streams and other microcosms are complex dynamic systems that can contribute to understanding of the behavior of toxic substances. It is suggested that laboratory stream research must become one of the many approaches to environmental toxicology in reference to watersheds and stream systems. (Author's abstract)
W89-01059

ACCUMULATION OF POLYCYCLIC AROMATIC HYDROCARBONS IN ACID SENSITIVE LAKES,
Indiana Univ. at Bloomington. School of Public and Environmental Affairs.
E. T. Furlong, L. R. Cessar, and R. A. Hites.
Geochimica et Cosmochimica Acta GCACAK, Vol. 51, No. 11, p 2965-2975, November 1987. 4 fig, 23 tab, 39 ref.

Descriptors: *Hydrocarbons, *Lakes, *Water pollution sources, *Pollution load, *Sediments, *Sulfur, *Metals, *Acid rain, Adirondacks, Precipitation, Hydrogen ion concentration, Chemical analysis, Watersheds, Acidic water, Lead, Lake sediments.

Polycyclic aromatic hydrocarbon concentrations and fluxes were measured in Pb dated sediment cores taken from nine lakes in four regions identified as susceptible to acidification. Calculated PAH accumulations were compared with historic S emissions, accumulation of sedimentary S, and anthropogenic metal accumulations to determine if PAH could be used as an indicator of combustion-derived sulfate deposition. Comparisons between regions indicated that the Adirondacks have a significantly higher burden of PAH than do northern New England, the northern Great Lakes States, and northern Florida. This difference likely results from significant upwind PAH sources to the Adirondack lakes. Detailed investigation of the largest lake in the study set, Big Moose Lake, indicates that PAH may serve as conservative, combustion indicators in large lakes. In this lake, PAH fluxes and concentrations were significantly correlated with historical S emission rates. These data suggest that PAH measured in sediment cores from large lakes can serve as indicators of past combustion product deposition. (Author's abstract)
W89-01074

VARIABILITY OF DISSOLVED TRACE METALS IN THE MISSISSIPPI RIVER,
Massachusetts Inst. of Tech., Cambridge. Dept. of Earth, Atmospheric and Planetary Sciences.
A. M. Shiller, and E. A. Boyle.
Geochimica et Cosmochimica Acta GCACAK, Vol. 51, No. 12, p 3273-3277, December 1987. 2 fig, 2 tab, 11 ref.

Descriptors: *Water pollution sources, *Trace metals, *Mississippi River, Chemical analysis, Metals, Copper, Nickel, Cadmium, Iron, Zinc, Sampling, Chromium, Molybdenum, Data acquisition, Geochemistry, Time series analysis, Vanadium, Water analysis.

The concentration of eight dissolved trace metals were measured in the lower Mississippi River seven times at various flow stages during a two-year interval. Using trace metal sampling and analysis techniques demonstrated to be reliable, these metals are shown to occur at levels lower than frequently reported. There systematic relations between the metals and discharge which can serve as predictors of metal variability. Anthropogenic contributions cannot be assessed accurately from these data but do not appear to cause the concentrations of most of these metals to be significantly higher than observed in less disturbed systems, with the possible exception of Ni and Cd. (Author's abstract)
W89-01075

COPPER BINDING BY DISSOLVED ORGANIC MATTER: I. SUWANNEE RIVER FULVIC ACID EQUILIBRIA,
North Carolina Univ., Chapel Hill. Dept. of Environmental Sciences and Engineering.
S. E. Cabaniss, and M. S. Shuman.
Geochimica et Cosmochimica Acta GCACAK, Vol. 52, No. 1, p 185-193, January 1988. 8 fig, 3 tab, 34 ref.

Descriptors: *Copper, *Suwannee River, *Fulvic acids, *Water chemistry, *Toxicity, *Organic carbon, Rivers, Chemical analysis, Model studies, Hydrogen ion concentration, Regression analysis, Dissolved solids.

A cupric ion-selective electrode measured free Cu in solutions of Suwannee River fulvic acid (FA) in a series of 30 titrations carried out both at variable and at constant, 5.14, 7.00, 8.44, pH. Total Cu varied 0.1-100 micro M, dissolved organic carbon 1-10 mg C/ liter, Ca and Mg 0-10 mM, and ionic strength 0.005-0.1. Copper complexation by FA is first order in dissolved organic carbon for 1-10 mg C/liter, and variable order in pH. Increasing Ca++ or Mg++ from 0 to 10 mM slightly increases Cu(++) activity, while increasing ionic strength from 0.005 to 0.1 significantly increases Cu(++) activity. An empirical N-site model was calibrated using a pooled set of six titrations with varying pH and dissolved organic carbon. Five binding components of varying proton dependence predict Cu binding by FA over a range of pH, dissolved organic carbon and total Cu in two verification tests of the model parameters. Parameters in this and other models tested are only empirical constructs. (See also W89-01078) (Author's abstract)
W89-01077

COPPER BINDING BY DISSOLVED ORGANIC MATTER: II. VARIATION IN TYPE AND SOURCE OF ORGANIC MATTER,
North Carolina Univ., Chapel Hill. Dept. of Environmental Sciences and Engineering.
S. E. Cabaniss, and M. S. Shuman.
Geochimica et Cosmochimica Acta GCACAK, Vol. 52, No. 1, p 195-200, January 1988. 5 fig, 4 tab, 21 ref.

Descriptors: *Water chemistry, *Toxicity, *Copper, *Dissolved solids, *Organic carbon, *Fulvic acids, *Suwannee River, Calibrations, Rivers, Model studies, Hydrogen ion concentration, White Oak River.

Copper binding properties of several fulvic acid (FA) and whole water samples were compared by means of an empirical model that was calibrated using Suwannee River FA. Within the calibration limits of the model (pH 5.0-8.5, total Cu concentration 0.1-100 micro M, ionic strength 0.1, and dissolved organic carbon, DOC, 1-10 mg C/l), pCu in solutions of a variety of FA samples are predicted with less than 0.2 pCu units root mean square error. Within the calibration limits, many whole water sample pCu's are predicted with less than 0.3 pCu units root mean square error if only one-half of the dissolved organic carbon is assumed to bind Cu. Agreement between prediction and experiment at lower ionic strength is not as good. Variations in Cu binding among different sources of dissolved organic matter appear to be much smaller than those due to chemical factors such as pH and ionic strength. (See also W89-01077) (Author's abstract)
W89-01078

REACTIVITY OF THE CARBONATE RADICAL WITH ANILINE DERIVATIVES,
Environmental Protection Agency, Athens, GA. Southeast Environmental Research Lab.
R. A. Larson, and R. G. Zepp.
Environmental Toxicology and Chemistry ETOCDK, Vol. 7, No. 4, p 265-274, April 1988. 4 fig, 5 tab, 30 ref.

Descriptors: *Dyes, *Path of pollutants, *Fate of pollutants, *Carbonates, *Kinetics, *Carcinogens, *Anilines, *Toxicity, Aquatic environment, Dissolved solids, Radioactive half-life, Aromatic compounds, Phenols, Sulfides.

Carbonate radicals generated by the photolysis of H2O2 at 313 nm in aqueous sodium bicarbonate, pH 8.3, or carbonate, pH 11.6, solution reacted with substituted aromatic amine derivatives. Particularly fast reactions were observed with anilines bearing electron-donating substituents, either on the ring or at the nitrogen atom. The results suggest that carbonate radicals may play a significant role in the removal of some aromatic amines from the aquatic environment, particularly in carbonate-rich waters. (Author's abstract)
W89-01088

NITRILOTRIACETIC ACID (NTA) ENVIRONMENTAL MONITORING PROGRAM IN INDIANA: 1979 TO 1983,
Procter and Gamble Co., Cincinnati, OH. Environmental Safety Dept.

For primary bibliographic entry see Field 5A.
W89-01089

AEROBIC BIODEGRADATION OF NATURAL AND XENOBIOTIC ORGANIC COMPOUNDS BY SUBSURFACE MICROBIAL COMMUNITIES,

North Carolina Univ., Chapel Hill. Dept. of Environmental Sciences and Engineering.
C. M. Swindoll, C. M. Aelion, D. C. Dobbins, O. Jiang, and S. C. Long.

Environmental Toxicology and Chemistry ETOCDK, Vol. 7, No. 4, p 291-299, April 1988. 1 fig, 3 tab, 33 ref.

Descriptors: *Aerobic conditions, *Biodegradation, *Organic compounds, *Fate of pollutants, *Groundwater, *Kinetics, *Xenobiotics, Groundwater pollution, Microbial degradation, Aquifers, Pollutants, Mineralization, Soil environment.

Studies were conducted to characterize the diversity of degradative abilities of microbial communities from pristine aquifer solids samples. Biodegradation was measured in aquifer solids slurries as both the conversion of radiolabeled substrate to 14 CO2 and the incorporation of label into cell biomass. Under aerobic conditions, the microbial community metabolized the following naturally occurring compounds: acetic acid, amino acids, cellulose, cinnamic acid, glucosamine and glucose. Several kinetic parameters were calculated from the uptake and mineralization data. For some compounds, respiratory enzymes became saturated, whereas incorporation into biomass was first-order. The results show that uptake into cell biomass reporesents a large fraction of total metabolism for many of the xenobiotic compounds. 14 C-most-probable-number (MPN) of substrate degraders was calculated. MPNs for naturally occurring compounds ranged from 100 to 1,000,000/gram of soil. There were generally fewer than 10 xenobiotic degraders/gram of soil. The biodegradative activity of the subsurface community appears to differ in both rate and product distribution from the activities of aquatic or surface-soil communities. (Author's abstract)
W89-01090

ORGANOCHLORINE AND MERCURY RESIDUES IN WILD MINK AND OTTER: COMPARISON WITH FISH,

New York State Dept. of Environmental Conservation, Gloversville. Hale Creek Field Station.
R. E. Foley, S. J. Jackling, R. J. Sloan, and M. K. Brown.

Environmental Toxicology and Chemistry ETOCDK, Vol. 7, No. 5, p 363-374, May 1988. 1 fig, 10 tab, 23 ref.

Descriptors: *Mercury, *Mink, *Chlorinated hydrocarbons, *Path of pollutants, *Bioaccumulation, *Otter, *Polychlorinated biphenyls, *DDE, Chemical analysis, Rivers, Heavy metals, New York, Tissue analysis, Body burden.

Organochloride and mercury levels in wild mink and otter from eight areas of New York State were measured in adipose and liver tissues. Polychlorinated biphenyl (PCB) compounds, were detected in all animals. Significantly greater concentrations of organochlorines in both species were associated with habitat known to be contaminated with PCB. Wet-weight PCB concentrations in adipose tissue of mink and otter from the more contaminated areas ranged as high as 67 and 114 microg/g. Mercury concentrations in liver tissue were similar in both species. Comparisons of the mink and otter body burdens with data from fish from New York's statewide Toxic Substance Monitoring Program were made. To test the hypothesis that organochlorine contaminant concentrations in mink and otter are related to environmental levels, collection locations of fish were paired with those of mink or otter on the basis of the size of the home range of the respective mammal. Correlations between fish and both mammalian species were significant for PCB and p,p-DDE when fish and mustelid collection stations were between 10 and 20 km apart. Correlations for mercury in fish and mustelids were significant only on the basis of major watershed. (Author's abstract)
W89-01093

SORPTION OF CATIONIC OLIGOMERS ON SEDIMENTS,

SRI International, Menlo Park, CA. Physical Chemistry Dept.
R. T. Podoll, and K. C. Irwin.

Environmental Toxicology ETOCDK, Vol. 7, No. 6, p 405-415, June 1988. 11 fig, 4 tab, 9 ref. EPA Contract 68-02-3968.

Descriptors: *Path of pollutants, *Fate of pollutants, *Sorption, *Cations, *Adsorption, *Sediments, *Oligomers, Isotherms, Nitrogen, Thermodynamics, Cation exchange, Chemical analysis.

The adsorption and desorption of oligomers of cationic poly(ethylenimine) (PEI) and poly (N,N-dimethylaminoethyl methacrylate) (PDAM), which may be very toxic to aquatic organisms, were measured on several sediments as part of a project to assess the effects and fate of water-soluble oligomers. The adsorption isotherms have a Langmuir shape, with high initial slopes for PEI and adsorption capacities of up to 13% oligomer adsorbed by weight for PDAM. Sorption capacity correlates with the cation exchange capacity for both oligomers. Sorption capacity increases with PEI molecular weight but is independent of PDAM molecular weight. Adsorption/desorption reversibility is < 15% at all surface coverages for PDAM and for PEI at low surface coverage, but increases up to 50% for PEI at high surface coverage. These data indicate that PDAM adsorbs with all protonated nitrogens directly attached to cation exchange sites at all surface coverages. In contrast, PEI appears to adsorb with a significant mass of adsorbed material in loops and tails indirectly attached to the surface. Adsorption of PDAM appears to increase dramatically if the sediment pH is basic enough to allow bilayer adsorption in the interlamellar region of the sediment. Preadsorption of PDAM on a sediment significantly increased the adsorption of naphthalene from water, suggesting that the lipophilicity of sediments or soils can be substantially increased by oligomer adsorption. (Author's abstract)
W89-01094

RADIONUCLIDES IN DRINKING WATER,

Maine Univ., Orono. Dept. of Civil Engineering.
J. D. Lowry, and S. B. Lowry.

Journal of the American Water Works Association JAWWA5, Vol. 80, No. 7, p 50-64, July 1988. 11 tab, 93 ref.

Descriptors: *Water pollution sources, *Water treatment, *Radioisotopes, *Drinking water, *Groundwater pollution, Water pollution effects, Radon, Radium radioisotopes, Uranium, Thorium radioisotopes, Radioactive wastes, Regulations, Aeration, Membrane processes, Ion exchange, Reverse osmosis, Dialysis, Adsorption, Activated carbon, Well water, United States.

Drinking water may contain radionuclides from natural and man-made sources. The natural radionuclides of most interest are radon, radium, and uranium. Rn-222 is found in groundwater, usually from low yield, granitic bedrock wells. The highest concentrations are often found in small public supplies or private wells (from <10 pCi/liter in surface water to 1,000,000 pCi/liter in a private supply). Public groundwater supplies with elevated Rn-222 levels were found primarily in Virginia, North and South Carolina, New England, and at scattered locations in the Midwest and West. Overall population-weighted-average values were 200 to 600 pCi/liter. It is believed that high levels of Rn-222 are spread over a much larger geographical area. However, the data base for the country as a whole is extremely poor. Most groundwater supplies would not be in compliance with a maximum contamination level (MCL) of 160 pCi/liter. Radium, also found in groundwater, is primarily in four aquifer regions: Coastal Plain, Piedmont, North Central, and Colorado Plateau. The population-weighted average in public water supplies is estimated to be 0.3 to 1.0 pCi/liter. Little is known about radium levels in private wells, where concentrations as high as 200 pCi/liter have been reported. Uranium is found in both surface water and groundwater, primarily in the West. Average uranium concentrations in public supplies are estimated in surface and groundwater at 1.0 and 3.0 pCi/liter, respectively. An estimated 1.5 million persons are served by drinking water supplies with uranium levels greater than the 5 pCi/liter MCL. Thorium levels are generally less than 0.1 pCi/liter. About 200 man-made radionuclides are considered potential drinking water contaminants. They reach the water supply by fallout, nuclear powerplant discharges, discharges from medical facilities, and leaching from waste disposal facilities. Rn-222 can be easily stripped from water by aeration. Anion exchange and the radium complexer have extremely high capacities for U, Ra, and Rn-222. Granular activated carbon is effective for long periods because of an adsorption-decay phenomenon. (Cassar-PTT)
W89-01104

OCCURRENCE OF RADON IN WELL SUPPLIES,

American Water Works Service Co., Voorhees, NJ. System Water Quality Dept.
K. L. Dixon, and R. G. Lee.

Journal of the American Water Works Association JAWWA5, Vol. 80, No. 7, p 65-70, July 1988. 1 fig, 8 tab, 9 ref.

Descriptors: *Water pollution sources, *Water treatment, *Radon, *Wells, *Groundwater pollution, Activated carbon, Adsorption, Aeration, Water storage, Storage, Water treatment facilities, Performance evaluation, Contact time, Radioactive waste.

Highest levels of radon in well water were in the northeastern United States and were associated with formations of uranium-bearing granitic rocks, according to a 1986-1987 survey of 377 wells within the American Water Works Company system. A study of the storage of radon-containing water showed that abut 18% of the original radon had dissipated on each day of the two-day test; 66% of the dissipation was attributed to volatilization. Blending of radon-free surface water with radon-containing groundwater reduced radon levels in the blended water as a function of volumetric dilution. Radon was removed from water by granular activated carbon adsorption, but the required contact time (130 min empty bed contact time for 99% removal) would be prohibitive to many water utilities. Additional problems are the release of radon into the water supply during backwashing of the system and the disposal of the spent radioactive carbon. Aeration was very effective for removing radon from water. Packed tower aerators achieved a >95% reduction in radon concentration; cascading tray aerators, >75% reduction. (Cassar-PTT)
W89-01105

OCCURRENCE OF RADON, RADIUM, AND URANIUM IN GROUNDWATER,

Environmental Protection Agency, Cincinnati, OH.
J. P. Longtin.

Journal of the American Water Works Association JAWWA5, Vol. 80, No. 7, p 84-93, July 1988. 8 fig, 12 tab, 7 ref.

Descriptors: *United States, *Water pollution sources, *Groundwater pollution, *Radium radioisotopes, *Radon radioisotopes, *Uranium radioisotopes, National Inorganics and Radionuclides Survey, Hydrologic data collections.

Radionuclides were determined in 1000 groundwater supplies during a survey, National Inorganics and Radionuclides Survey, authorized by the EPA. Radionuclides of interest were radon, radium 226 and 228, and uranium. Water supplies serving four population categories were targeted for sampling: very small (25-500); small (501-3300); medium (3301-10,000); and large/very large (10,001-100,000). Radon activity exceeded the minimum reporting level (MRL) of 100 pCi/liter at 71.9% of the sites. The population-weighted averages for radon were 194 pCi/liter for sites serving

>1000 people; 602 pCi/liter for those serving <1000 people; and 249 pCi/liter overall. Radium-226 activities equaled or exceeded the MRL of 0.18 pCi/liter at 40.2% of the sites, with a maximum activity of 15.1 pCi/liter. About 90% of the Ra-226 activities were <1 pCi/liter; 1% were >5 pCi/liter. The MRL of 1 pCi/liter for Ra-228 was exceeded at 11.9% of the sites, with the maximum of 12.1 pCi/liter. About 0.8% of the Ra-228 values exceeded 1.0 pCi/liter; 1.7% exceeded 3.0 pCi/liter. Uranium occurred at a mean value of 1.86 microgram/liter; maximum, 88.2 microgram/liter. The percentage of sites with concentrations greater than the MRL of 0.08 microgram/liter was 72.2%. The percentage of sites with U concentrations >10 microgram/liter was 3.17. (Cassar-PTT)
W89-01108

SOURCE PROTECTION AND THE SMALL UTILITY,
Chautauqua County Dept. of Health, Mayville, NY. Div. of Environmental Health Services.
For primary bibliographic entry see Field 5G.
W89-01116

PESTICIDES: A CONTINUING DILEMMA,
Virginia Polytechnic Inst., Blacksburg. Water Resources Research Center.
T. M. Younos, and D. L. Weigmann.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 7, p 1199-1205, July 1988. 3 tab, 20 ref.

Descriptors: *Water pollution effects, *Environmental effects, *Pesticides, *Water pollution, *Fate of pollutants, *Pesticide toxicity, *Regulations, Organochlorines, Pyrethroids, Organic pesticides, Organophosphorus pesticides.

Environmental effects, fate and federal regulation of pesticides are reviewed. The era of modern synthetic organic chemicals known as pesticides began in the 1930s and was greatly advanced in the 1940s. Three major categories have developed, including: (1) organochlorines, (2) organophosphates, and (3) pyrethroids. Today, pesticides are used in agriculture for many diverse purposes such as human and animal health protection, pest control in forest and aquatic environments, and protection of buildings and other structures. Increased and continued pesticide use is associated with human health risks, adverse effects on non-target organisms, and contamination of air, soil and water. Residues from pesticides may occur in water, mud, sediment, plankton, suspended material, fish, other animals, and plants. The dynamics of pesticide interaction in an aquatic environment are quite complex and are influenced by a combination of physical, chemical and biological processes. All pesticides are toxic to humans and other organisms. The degree of harm to humans and other living organisms depends on pesticide characteristics, the amount or dosage, and the duration of exposure or contact time. Since publication of 'Silent Spring' in the early 1970s, much attention has been focused on the fate of pesticides in the environment. Elaborate monitoring and research programs are initiated by industry and state and federal agencies to study the fate of pesticides in surface and ground waters. The development of alternative and innovative technologies to shift from complete reliance on pesticides to other methods of pest control is one answer to the continued dilemma of pesticide pollution. For example, Integrated Pest Management combines various nonchemical techniques with judicious chemical applications. Advances in genetic engineering, biological control, and plant breeding may also result in the ultimate reduction of farm chemical use. However, at present, legal and regulatory issues have significantly slowed the development and testing of genetically engineered biological control agents. Intensive research and education programs and funds to support such programs are needed for new technologies to become available that will both reduce pesticide use and develop environmentally safe alternatives. (Miller-PTT)
W89-01122

DIFFUSE (NONPOINT) POLLUTION - A POLITICAL, INSTITUTIONAL, AND FISCAL PROBLEM,
Marquette Univ., Milwaukee, WI. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W89-01134

COPING WITH GROUNDWATER CONTAMINATION,
Johns Hopkins Univ., Baltimore, MD. Dept. of Environmental Engineering Science.
For primary bibliographic entry see Field 5G.
W89-01135

INFLUENCE OF ALTITUDE ON RAINFALL COMPOSITION AT GREAT DUN FELL,
Institute of Terrestrial Ecology, Edinburgh (Scotland).
D. Fowler, J. N. Cape, I. D. Leith, T. W. Choularton, and M. J. Gay.
Atmospheric Environment ATENBP, Vol. 22, No. 7 p 1355-1362, July 1988. 12 fig, 3 tab, 13 ref.

Descriptors: *Precipitation, *Altitude, *Rainfall, *Chemistry of precipitation, *Water pollution sources, *Acid rain, *England, Wet deposition, Cloud chemistry, Clouds, Wind, Sulfates, Nitrates, Chlorides, Ammonium, Hydrogen ion concentration.

Rainfall and wet deposition were investigated at Great Dun Fell in northern England. Measurements of rainfall at eight altitudes between 250 and 850 m on the western slopes of the hill show marked changes in both amount and composition when orographic cloud is present and a west or southwest wind is blowing. On the average (20 precipitation events from autumn 1984 and spring 1985), the rainfall at the summit (847 m) exceeded that at 250 m by a factor of 2, and concentrations of sulfate, nitrate, chloride, ammonium, and hydrogen ions were larger at the summit by factors of between 2.2 and 3.1. Thus, wet deposition at the summit was larger than at 250 m by about a factor of 5. The concentrations of major ions in orographic cloud at 847 m exceeded concentrations in rain by a factor of between 2.0 and 3.9. A large change occurred in the concentrations of major ions in orographic cloud with altitude, decreasing with increasing altitude from cloud base. Such changes could generally be explained by the expected dilution as cloud liquid water content increased adiabatically. When the wind was from the east or with blocked flow no increase in concentration with rainfall amount was observed. (See also W89-01147) (Author's abstract)
W89-01146

INFLUENCE OF ALTITUDE ON WET DEPOSITION: COMPARISON BETWEEN FIELD MEASUREMENTS AT GREAT DUN FELL AND THE PREDICTIONS OF A SEEDER-FEEDER MODEL,
University of Manchester Inst. of Science and Technology (England). Dept. of Pure and Applied Physics.
T. W. Choulartan, M. J. Gay, A. Jones, D. Fowler, and J. N. Cape.
Atmospheric Environment ATENBP, Vol. 22, No. 7 p 1363-1371, July 1988. 7 fig, 9 ref.

Descriptors: *Precipitation, *Data interpretation, *Acid rain, *Altitude, *Water pollution sources, *Chemistry of precipitation, *Model studies, *England, Comparison studies, Meteorological data collection, Prediction, Seeder-feeder model, Wet deposition, Topography, Rainfall rate, Clouds, Wind, Cloud physics, Case studies.

The influence of topography on rainfall rate and chemical composition was investigated at Great Dun Fell (GDF) in northern England. The measurements at eight different altitudes between 250 and 850 m above sealevel on the western slopes of GDF show, in the presence of a cap cloud on the hill and a west or southwest wind flow, a marked increase in both rainfall amount and concentrations of major ions with altitude. Three case studies of the variation in rainfall rate and chemical composition with altitude when the seeder-feeder mechanism was operating are described and compared with model predictions. Associated measurements of the cap cloud microphysics and chemistry were also made. The case studies show close agreement between model predictions and measured values for changes in chemical composition and wet deposition with altitude. This pattern of wet deposition is a frequent occurrence at GDF, but exceptions do occur, for example when the upstream flow is blocked or the wind speed is small, no increase in the concentration or rainfall amount was observed. (See also W89-01146) (Author's abstract)
W89-01147

OCCURRENCE AND DISTRIBUTION OF TRACE ORGANIC COMPOUNDS IN BERMUDA PRECIPITATION,
Bermuda Biological Station for Research, Ferry Reach.
A. H. Knap, K. S. Binkley, and R. S. Artz.
Atmospheric Environment ATENBP, Vol. 22, No. 7 p 1411-1423, July 1988. 7 fig, 5 tab, 34 ref.
NOAA Contract 50-EANA-5-0005/AR 5-0002.

Descriptors: *Precipitation, *Chemistry of precipitation, *Water pollution sources, *Trace levels, *Organic compounds, *Bermuda, Temporal distribution, Organochlorines, Air pollution, Atlantic Ocean, Pesticides, Hexachlorocyclohexane, Chlordane, Dieldrin, Air masses, North America.

Data are presented on the chemical composition of 36 rainwater events sampled in Bermuda during 1983 and 1984. Samples were analyzed for alpha and gamma isomers of hexachlorocyclohexane (HCH), chlordane, and dieldrin. Mean concentrations with standard errors found were 854 plus or minus 217 pg/l for alpha HCH, 126 plus or minus 27 pg/l for gamma HCH, 77 plus or minus 17 pg/l for chlordane, and 158 plus or minus 27 pg/l for dieldrin. The data indicate that higher concentrations of alpha HCH and gamma HCH in rainwater are associated with air masses originating in North America. The concentrations of the compounds in precipitation are highly variable and the deposition of the compounds is extremely episodic. The wet fluxes of chlordane and dieldrin are discussed in relation to deep-sea sediment trap measurements collected at 3200 m in the Sargasso Sea 25 km southeast of the rainwater sampling site and indicate a wet flux of 78-115 ng/sq m/yr for chlordane and 217-237 ng/sq m/yr for dieldrin which is 6-8 times higher than the measured deep-sea flux. (Author's abstract)
W89-01148

DISSOLUTION OF TRACE METALS FROM PARTICLES OF INDUSTRIAL ORIGIN AND ITS INFLUENCE ON THE COMPOSITION OF RAINWATER,
Leeds Univ. (England). Dept. of Fuel and Energy.
P. T. Williams, M. Radojevic, and A. G. Clarke.
Atmospheric Environment ATENBP, Vol. 22, No. 7 p 1433-1442, July 1988. 5 fig, 4 tab, 44 ref.

Descriptors: *Air pollution, *Precipitation, *Trace metals, *Industrial wastes, *Chemistry of precipitation, Particulate matter, Heavy metals, Iron, Zinc, Manganese, Calcium, Magnesium, Hydrogen ion concentration, Leaching, Aerosols.

The dissolution of Fe, Mn, Cu, Zn, Ca, and Mg from pulverized fuel ash and steel-dust particles in aqueous suspensions was studied as a function of solution pH and aerosol mass loading. The rate of dissolution, the final concentration, and the fraction of the metal leached increased with decreasing pH over the pH range 2.5 to >5. The leaching of aerosol particles is an important source of trace metals in rainwater, and the results of the leaching experiments were found to be consistent with the observations of these metals in urban rainwater. Alkaline materials such as Ca and Mg leached from particles may be important in the electroneutrality balance of rainwater and they could affect the solution pH. The dissolution of metals such as Fe and Mn may provide catalysts which could be important in the aqueous oxidation of sulfur diox-

ide, and the leaching of Ca and Mg may have a 'buffering' effect in reacting cloud and aerosol droplets. (Author's abstract)
W89-01149

AEROSOL AND HYDROMETEOR CONCENTRATIONS AND THEIR CHEMICAL COMPOSITION DURING WINTER PRECIPITATION ALONG A MOUNTAIN SLOPE: I. TEMPORAL EVOLUTION OF THE AEROSOL, MICROPHYSICAL AND METEOROLOGICAL CONDITIONS,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Atmospheric Physics Lab.
For primary bibliographic entry see Field 2B.
W89-01150

ACIDIC DEPOSITION DISTRIBUTION AND EPISODE STATISTICS FROM THE MAP3S NETWORK DATABASE,
Battelle Pacific Northwest Labs., Richland, WA. Atmospheric Sciences Dept.
M. T. Dana, and W. G. N. Slinn.
Atmospheric Environment ATENBP, Vol. 22, No. 7 p 1469-1474, July 1988. 2 fig, 5 tab, 10 ref. DOE Contract DE-AC06-76RLO 1830.

Descriptors: *Acid rain, *Precipitation, *Data interpretation, *Rainfall distribution, *Water pollution sources, *Statistical analysis, *MAP3S network, *Weather data collections, Probability distribution, Spatial distribution, Seasonal distribution, Chemistry of precipitation, Nitrates, Sulfates, Ammonium, Hydrogen, Rainfall intensity.

Data for precipitation and acidic-pollutant concentration from the MAP3S network in the eastern United States were analyzed to assess the probability distributions of acidic deposition and the spatial and temporal character of high-deposition events (or 'episodes'). About 20% of the precipitation events account for about 55% of the deposition of the major species (sulfur, nitrate, free hydrogen, and ammonium). The mean 'episodicity', as defined by Smith and Hunt, is 7%; this is not considered highly episodic. The distribution characteristics are spatially quite uniform over the MAP3S region, suggesting a homogeneous pollution-exposure environment. Occurrences of the leading deposition events generally follow the seasonal trends in concentration, and the major episodes usually account for about 10% or less of a given year's total deposition. Most episode events are characterized by above-normal values of both precipitation amount and concentration. (Author's abstract)
W89-01151

WET-ONLY PRECIPITATION STUDY IN A MEDITERRANEAN SITE, PATRAS, GREECE,
Patras Univ. (Greece). Dept. of Chemistry.
For primary bibliographic entry see Field 2B.
W89-01152

MERCURY IN FRESHWATER FISH AND CLAMS FROM THE CERRO PRIETO GEOTHERMAL FIELD OF BAJA CALIFORNIA, MEXICO,
Universidad Autonoma de Baja California (Mexico). Inst. de Investigaciones Oceanologicas.
E. A. Gutierrez-Galindo, G. Flores Munoz, and A. Aguilar Flores.
Bulletin of Environmental Contamination and Toxicology BECTA6. Vol. 41, No. 2, p 201-207, August 1988. 2 fig, 2, tab, 12 ref. Secretaria de Educacion Publica Grant 85-01-0157.

Descriptors: *Water pollution sources, *Fish, *Clams, *Geothermal studies, *Mercury, *Mexico, Tilapia, Corbicula, Watercourses, Tissue analysis, Atomic absorption spectroscopy, Food habits, Aquatic habitats, Canals, Water quality standards.

The Cerro Prieto field is located in the agricultural Mexicali Valley, approximately 40 km south of the USA-Mexican border. A study was conducted to assess the geothermal mercury pollution arising from Cerro Prieto; for this purpose the fish Tilapia mossambica and the clam Corbicula fluminea were collected from watercourses of the Mexicali Valley. Mercury was determined by cold-vapor atomic-absorption spectrometry. Mercury concentrations were higher in clams than in fish; the differences are probably associated with differences in feeding habits and with habitat differences in the bioavailability of mercury. The results indicated much higher concentrations of mercury in fishes living in water receiving considerable geothermal discharges (Rio Hardy) than in fishes living in similar waters receiving no geothermal discharges. However, clam samples collected far away from Cerro Prieto (Canal Coahuila and Canal Zacatecas) were found to contain higher levels of mercury (0.17 to 0.32 micrograms/gram) than samples collected within the geothermal field itself; the mercury anomalies reflected in these bivalves may yield information on the presence of shallow geothermal circulation patterns. None of the fish or clam samples yielded mean mercury levels exceeding the widely-accepted tolerance limit of 1.0 mg/kg (US Food and Drug Administration). (Shidler-PTT)
W89-01153

COMPARISON OF CHEMICAL BIODEGRADATION RATES IN BOD DILUTION AND NATURAL WATERS,
Wisconsin Univ.-Superior. Center for Lake Superior Environmental Studies.
D. D. Vaishnav, and E. T. Korthals.
Bulletin of Environmental Contamination and Toxicology BECTA6. Vol. 41, No. 2, p 291-298, August 1988. 1 fig, 2 tab, 16 ref. EPA Cooperative Agreement CR811603.

Descriptors: *Fate of pollutant, *Biochemical oxygen demand, *Biodegradation, Comparison studies, Microbial degradation, Phenols, Herbicides, Glucose, Metabolism, Culture media, Correlation analysis, Precision.

A study was conducted to measure biodegradation rates of nine chemicals in BOD-dilution water and to compare the rates with those reported in the literature for the same chemicals in five natural waters. Mixed microbial cultures capable of using phenol, p-methylphenol, p-methoxyphenol, p-chlorophenol, p-bromophenol, p-acetylphenol, p-cyanophenol, p-nitrophenol, an ester of 2,4-D, and glucose as sole carbon and energy sources were separately isolated by an enrichment culture technique. The cells were grown in mineral-salts medium containing 100 mg/L (solid) or 100 microL/L (liquid) chemical substrate. The biomass was centrifuged, suspended in physiological saline, incubated for 24 h, and diluted to 7.0 x 10 to the 7th cells/mL for use in biodegradation tests. The pseudo-first-order biodegradation rate constants ranged from 0.008/h for p-chlorophenol to 0.028/h for p-methylphenol. Both the statistically-significant linear correlations and the relatively-high levels of precision and accuracy, as measured in this study, suggest that the conventional BOD method can be adapted for estimating biodegradation rates of a large number of chemicals. Results suggested that biodegradation rates measured using this method were environmentally relevant, since they correlated well with rates in several of the natural waters. (Shidler-PTT)
W89-01158

STUDIES ON THE DEGRADATION OF SYNTHETIC DETERGENTS BY SEWAGE,
National Research Centre, Cairo (Egypt).
H. I. Abdel-Shafy, A. M. Azzam, and I. M. El-Gamal.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 41, No. 2, p 310-316, August 1988. 5 fig, 1 tab, 15 ref.

Descriptors: *Fate of pollutants, *Wastewater treatment, *Detergents, *Microbial degradation, *Wastewater, Domestic wastes, Municipal wastewater, Egypt, Aeration, Alkylbenzene sulfonates, Linear alkyl sulfonates, Surfactants.

In most cases, domestic detergent wastes are discharged together with municipal sewage into bodies of water. A study was designed to investigate the role of the natural microflora of the Ismailia Canal (Egypt), of sewage microflora, and of aeration on the degradation of synthetic detergents. Alkyl benzene sulfonate (ABS), linear alkyl sulfonate (LAS), and a 1:1 mixture of ABS and LAS were added to flasks containing canal water. Each detergent formulation was tested without aeration, with aeration, and with 0.5 and 1.0 ml/L sewage from the Ismailia sewage plant. Detergent degradation was measured every 12 hours during 7 days' incubation. The results showed that the degradation rate of the studied detergents was enhanced markedly by aeration and/or adding sewage as a source of microflora. Increasing the concentration of this microflora increased the degradation rate. In addition, the degradation of the hard surfactant ABS could be increased by mixing it with the soft surfactant LAS. (Shidler-PTT)
W89-01159

SEPTIC SYSTEM PERFORMANCE ON A COASTAL BARRIER ISLAND,
Washington State Univ., Puyallup. Western Washington Research and Extension Center.
For primary bibliographic entry see Field 5D.
W89-01163

SORPTION AND DEGRADATION OF ALDICARB AND ITS OXIDATION PRODUCTS IN A SOIL-WATER FLOW SYSTEM AS A FUNCTION OF PH AND TEMPERATURE,
Cornell Univ., Ithaca, NY.
A. T. Lemley, R. J. Wagenet, and W. Z. Zhong.
Journal of Environmental Quality JEVQAA, Vol. 17, No. 3, p 408-414, July-September 1988. 2 fig, 6 tab, 20 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Soil water, *Pesticides, *Aldicarb, *Sorption, *Degradation, *Hydrogen ion concentration, *Soil temperature, Aldicarb sulfoxide, Aldicarb sulfone, Loam, Soil columns, Data interpretation, Mathematical analysis, Convection, Thermodynamics, Solute transport.

Aldicarb--2-methyl-2-(methylthio)propionaldehyde O-(methylcarbamoyl)oxime, aldicarb sulfoxide--2-methyl-2-(methylsulfinyl)propionaldehyde O-(methylcarbamoyl)oxime, and aldicarb sulfone--2-methyl-2-(methylsulfonyl)propionaldehyde O-(methylcarbamoyl)oxime in a sandy loam soil were studied under varying pH and temperature conditions. The experiments were performed using a soil-column methodology, which allows a steady-state water flow and nonsteady-state addition of pesticide. The elution curve (concentration vs. time) was interpreted using analytical solutions to the convection-dispersion equation that included linear sorption and pseudo-first-order degradation. The sorption of the three species changes slightly with pH over the range studied (pH 5-8). The degradation varies with pH, but not in the same manner as found in aqueous solution studies. Sorption decreases as the temperature is increased from 15 to 35 C. Degradation is also temperature-dependent in this range and for aldicarb sulfone can be represented by a linear Arrhenius plot from which activation energies can be derived. There is good agreement between the calculated activation energy for aldicarb sulfone and that obtained in aqueous solution studies. The results provide information about the thermodynamics of the aldicarb system and demonstrate the usefulness of the soil-column flow method as a good laboratory model for chemical transport and transformation in soil. (Author's abstract)
W89-01164

HYDROGEN ION CONCENTRATION AND ALKALINITY OF RESERVOIR WATER IN THE SIERRA NEVADA, CALIFORNIA, AND CORRELATIONS WITH AIR POLLUTANTS,
California Univ., Berkeley. Dept. of Plant and Soil Biology.
J. G. McColl.
Journal of Environmental Quality JEVQAA, Vol. 17, No. 3, p 425-430, July-September 1988. 6 fig, 5 tab, 10 ref. Hatch Project CA-B-PSB-3664-H.

Descriptors: *Air pollution effects, *Acid rain, *Reservoirs, *Hydrogen ion concentration, *Water

pollution sources, *Alkalinity, *California, *Sierra Nevada, Forest watersheds, Water analysis, Acidity, Nitrogen compounds, Sulfur compounds, Oxides, Correlation analysis, Snowpack, Snowmelt, Runoff, Cations.

Pardee reservoir supplies water for the east San Francisco Bay Area from a large forested drainage basin located in the Sierra Nevada foothills and extending east to the crest of the mountain range. Weekly analyses of reservoir discharge water indicate that acidity has been increasing (1954-1985 data) and alkalinity decreasing (1944-1985 data). Acidity and alkalinity of reservoir water are correlated with nitrogen oxide (and, to a lesser extent, sulfur dioxide) emissions from the San Francisco Bay Area. Emissions of oxides of nitrogen are about four times greater than those of sulfur dioxide. A lag time of 3 to 4 yr improves the correlations, especially those for sulfur dioxide. Greatest increases in pH occur in spring when the snowpack is melting. In the 1950s, spring melt had a dilution effect on hydrogen-ion concentration, but now pH increases during the spring melt. Atmospheric oxides of nitrogen and sulfur appear to have their greatest effect on hydrogen-ion concentration in water when there is little contact between runoff and soils and rocks. There is no correlation between acidity and alkalinity during the winter when water penetrates the soil profile, resulting in proton exchange with soil 'base cations'. During summer, when runoff is minimal, other processes within the reservoir appear to control acidity and alkalinity. There are alternative hypotheses which may help explain the observed trends in acidity and alkalinity over seasons and years; these hypotheses largely involve within-reservoir processes, but without historical data their importance remains unclear. (Author's abstract)
W89-01165

EFFECTS OF LEACHING AND WHOLE-TREE HARVESTING ON CATION BUDGETS OF SEVERAL FORESTS,
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 4C.
W89-01166

ANNUAL ELEMENTAL INPUT/OUTPUT ESTIMATES FOR TWO FORESTED WATERSHEDS IN EASTERN TENNESSEE,
Tennessee Valley Authority, Oak Ridge.
J. M. Kelly.
Journal of Environmental Quality JEVQAA, Vol. 17, No. 3, p 463-468, July-September 1988. 7 tab, 31 ref.

Descriptors: *Solute transport, *Forest watersheds, *Acid rain, *Path of pollutants, *Tennessee, Chemistry of precipitation, Sulfates, Nitrates, Phosphates, Precipitation, Streamflow, Ammonium, Calcium, Magnesium, Sodium, Hydrogen ion concentration, Air pollution, Hydrologic budget.

Atmospheric inputs of sulfate, nitrate, phosphate, ammonium, calcium, magnesium, sodium, and hydrogen ions via wet and dry deposition were compared with stream-water outputs at two study sites, Camp Branch and Cross Creek, during the period 1978 to 1983. The Cross Creek site is located 19 km from a major coal-fired point source and has been subjected to approximately 30 yr of elevated atmospheric input while Camp Branch is located in an area removed from the possible local influences of a major point source. Hydrologic comparison of mean streamflow output to incoming precipitation indicates a greater loss of water (64%) to streamflow at Cross Creek than Camp Branch (56%). No site differences could be detected in mean annual wet input for any element. The dryfall comparison indicated only a higher level of magnesium-ion input at Cross Creek. The relative contributions of anions in both wetfall and dryfall (import) and in streamflow (export) at both sites was sulfate > nitrate > phosphate for the anions. The order was hydrogen > calcium > ammonium > sodium > magnesium > potassium for the cations in wetfall and dryfall. The sulfate ion accounted for 86% of the measured streamflow anion export at Camp Branch and 91% at Cross Creek. Although sulfate export varied between sites as a function of flow, concentration values remained relatively constant from year to year. Cation export was dominated by magnesium at Camp Branch, followed by calcium > sodium > potassium > ammonium > hydrogen. At Cross Creek, the order of cation export was magnesium > calcium > sodium > potassium > hydrogen > ammonium. Comparing base-cation inputs to outputs, there is a mean efflux at Cross Creek. Notwithstanding that sulfate-retention rates are 78% of input, sulfate is still the dominant measured companion anion, though there is circumstantial evidence for a substantial bicarbonate contribution. The hydrogen-ion input is also almost completely retained within the system. Base-cation loss at Cross Creek was 31% higher than that at Camp Branch. However, it is difficult to demonstrate any significant impact of the elevated historical sulfur input because nutrient export was highly correlated with streamflow and streamflow volume was 29% higher at Cross Creek. (Author's abstract)
W89-01168

BACTERIAL WATER QUALITY RESPONSES TO FOUR GRAZING STRATEGIES: COMPARISONS WITH OREGON STANDARDS,
Forest Service, Portland, OR. Pacific Northwest Research Station.
A. R. Tiedemann, D. A. Higgins, T. M. Quigley, H. R. Sanderson, and C. C. Bohn.
Journal of Environmental Quality JEVQAA, Vol. 17, No. 3, p 492-498, July-September 1988. 4 fig, 2 tab, 31 ref.

Descriptors: *Water pollution sources, *Water quality standards, *Bacterial analysis, *Nonpoint pollution sources, *Grazing, *Oregon, Stream pollution, Watersheds, Range management, Feces, Coliforms, Streptococcus, Livestock, Cattle, Wildlife.

Concentrations of fecal coliforms (FC) and fecal streptococci (FS) were measured weekly during the summer of 1984 in the streamwater of 13 wildland watersheds managed under four range-management strategies. The strategies were (A) no grazing; (B) grazing without management for livestock distribution; (C) grazing with management for livestock distribution; and (D) grazing with management for livestock distribution and with cultural practices to increase forage. Counts of FC were compared with Oregon water quality standards. The FC/FS ratio was used to assess the origin of FC organisms. Counts of FC were significantly lower under strategies A and C than under strategy D, but no significant differences were apparent among other strategy comparisons. Two strategy-D watersheds violated the Oregon water-quality 30-d log standard of no more than 2000 FC/L (200 FC/100 mL). One watershed was in violation for most of the sampling period. Ratios of FC to FS indicated that wildlife was the major source of FC bacteria in strategy-A, -B, and -C watersheds. Cattle were the primary source of FC bacteria on strategy-D watersheds. (Author's abstract)
W89-01170

SHALLOWLY PLACED, LOW PRESSURE DISTRIBUTION SYSTEM TO TREAT DOMESTIC WASTEWATER IN SOILS WITH FLUCTUATING HIGH WATER TABLES,
Law Environmental, Inc., Kennesaw, GA.
For primary bibliographic entry see Field 5D.
W89-01171

STREAM ACIDIFICATION TRENDS IN THE WELSH UPLANDS: A MODELLING STUDY OF THE LLYN BRIANNE CATCHMENTS,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 5C.
W89-01206

RELATIONSHIP BETWEEN GLACIAL GEOLOGY AND STREAMWATER CHEMISTRY IN AN AREA RECEIVING ACID DEPOSITION,
State Univ. of New York at Buffalo. Dept. of Biological Sciences.
R. A. Phillips.
Journal of Hydrology JHYDA7, Vol. 101, No. 1-4, p 263-273, June 30, 1988. 1 fig, 4 tab, 17 ref.

Descriptors: *Path of pollutants, *Geochemistry, *Acid rain, *Glacial drift, New York, Alkalinity, Hydrogen ion concentration, Calcium, Conductivity, Sulfates, Water pollution effects, Air pollution, Geology, Geochemistry.

Seventy streams in southwestern New York State were sampled in June and again in December. Streamwater chemistry proved to be closely associated with glacial geology. Streams in glaciated area watersheds had higher pH, alkalinity, calcium, and conductivity values than streams in unglaciated area watersheds. Within the glaciated area, streams of the Kent Drift Sheet had higher alkalinity, calcium and conductivity values than streams of the Olean Drift Sheet. Streamwater sulfates were also analyzed in December, and were found to be highest in the Kent Drift Sheet. Glacial geology of a watershed is well predicted by discriminant analysis of streamwater chemistry data. Additional buffering capacity provided by glacial till appears to override sulfate adsorption considerations in making the glaciated area streams less susceptible to atmospheric acid deposition. (Author's abstract)
W89-01210

ESTIMATING SOIL/SEDIMENT PARTITION COEFFICIENTS FOR ORGANIC COMPOUNDS BY HIGH PERFORMANCE REVERSE PHASE LIQUID CHROMATOGRAPHY,
Michigan Univ., Ann Arbor. Dept. of Environmental and Water Resources Engineering.
Y. P. Chin, C. S. Pevin, and W. J. Weber.
Water Research WATRAG, Vol. 22, No. 7, p 873-881, July 1988. 5 fig, 4 tab, 54 ref. Michigan Seagrant College Program Project R/TS-29, NOAA Office of Seagrant Grant NA86AA-0-SG043, and NSF Environmental Engineering Program Project ECE-8503903.

Descriptors: *Fate of pollutants, *Soil contamination, *Sediments, *Path of pollutants, *Sorption, *Organic compounds, *Chromatography, Model studies, Lake sediments, Sand aquifers, 2,5,2'-PCB, Chlordane, Correlation analysis.

High-performance reverse-phase liquid chromatography (HPRPLC) retention parameters were correlated with organic-carbon-normalized partition-coefficient values (OCNPC) for sorption of various uncharged organic substances onto sediment and soil in an attempt to devise a model for predicting sorption behavior. The sediment used for this study was obtained from Lake Michigan. The sandy soil, collected from Michawye, MI, was chosen for its low and uniform organic carbon content, and closely resembles sands in many aquifers, providing a useful basis for measurement of sorption of organic compounds in subsurface systems. Partition coefficients of 2,5,2'-PCB were 2295 for the lacustrine sediment and 37.70 for the Michawye soil; for chlordane they were 5216 for sediment and 182.7 for soil. The results reveal a relationship between the logarithm of HPRPLC retention time and log OCNPC that appears to provide a reasonable means for estimating partitioning properties from HPRPLC data. The technique was compared with methods which utilized octanol/water partition coefficients and aqueous solubilities as surrogate predictors of sorption behavior and was found to yield superior correlations in all cases tested. (Author's abstract)
W89-01223

TRANSPORT MODELLING OF BIOLOGICAL TRACERS FROM SEPTIC SYSTEMS,
Wisconsin Univ.-Madison. Water Resources Center.
B. J. Alhajjar, S. L. Stramer, D. O. Cliver, and J. M. Harkin.
Water Research WATRAG, Vol. 22, No. 7, p 907-915, July 1988. 3 tab, 39 ref.

Descriptors: *Path of pollutants, *Septic tanks, *Tracers, *Model studies, *Environmental tracers, *Groundwater pollution, Chlorides, Conductivity, Pathogens, Bacteria, Viruses, Bioindicators, Coliforms, Streptococcus, Effluents, Wells, Water table fluctuations, Feces, Poliovirus, Statistical analysis, Water quality standards.

The potential of contamination of individual groundwater supplies from septic systems was investigated. Chloride and electrical conductivity as tracers of chemicals and indicator bacteria (total and fecal coliforms and fecal streptococci) were determined for 7 months in septic-tank effluent and groundwater samples collected downgradient from 17 new or replacement septic systems. Indicator bacteria were also determined occasionally in groundwater samples from wells near the systems for a continuing period of 2 years. Following 5 years of system operation a last round of analyses was conducted. Water-table fluctuations in the vicinity of the septic systems were monitored for 2 years. As a model for viruses, poliovirus in feces from babies who had received trivalent Sabin oral poliovirus vaccine was introduced into one septic system as a single dose by flushing stools down the toilet. Effluent and groundwater were assayed for poliovirus over a period of approximately 6 months. The data were evaluated statistically and a biological-contaminant-transport model was tested to simulate groundwater contamination by the tracers of pathogens. No tracer bacteria reached groundwater from any of the 17 septic systems. Presumably, the bacteria were removed by the soil under the seepage bed; mean transport was <1 count/100 ml for each bacterial type, in keeping with U.S. drinking-water regulations. Poliovirus entered and spread in groundwater from the one septic system tested, even though this system was functioning properly. Of 3.3 x 10 to the 8th PFU (plaque-forming units) of poliovirus inoculated into the septic tank, a mean of 70 PFU/100 ml escaped from the tank with the effluent and an overall mean of 62 PFU/100 ml were transported to groundwater. Septic systems had little influence on water-table fluctuations in their vicinity, compared with the seasonal climatic factors. (Author's abstract)
W89-01226

BINDING OF HEAVY METALS TO ALGAL SURFACES,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
H. B. Xue, W. Stumm, and L. Sigg.
Water Research WATRAG, Vol. 22, No. 7, p 917-926, July 1988. 9 fig, 1 tab, 25 ref.

Descriptors: *Path of pollutants, *Adsorption, *Heavy metals, *Algae, Natural waters, Cations, Copper, Cadmium, Chlamydomonas, Hydrogen ion concentration, Voltammetry, Metal complexes, Kinetics.

Biological particles can profoundly influence the distribution of heavy metals in natural waters because the functional groups on the cell surfaces are able to bind metal ions. The interaction of Cu(II) and Cd(II) was evaluated from titration of algal suspensions (Chlamydomonas rheinhardii) (i) at a constant pH with increments of metal ions and (ii) in the presence of the metal ions with increments of acid. A voltammetric methodology was developed to measure (without prior separation of the solid phase) the metal ions in solution in the presence of algae and to assess the binding of metals to the surfaces of algae. The surfaces of algal cells have a high affinity for Cu(II) and Cd(II), even in the presence of 0.001 M Ca(2+); their functional-group ligands can compete with soluble complex formers typically present in natural waters. The adsorption of metals is readily interpreted in terms of surface-complex-formation equilibria or--mathematically equivalent--Langmuir-type adsorption equilibria. The 'average' conditional equilibrium constant extracted from the experimental data permits a generalization valid for a certain range of metal surface loading and can be used in multi-metal multi-ligand speciation calculations. Understandably, the data cannot be fitted over a large range of free-metal-ion concentrations or metal loading of the surface because the tendency to form surface complexes decreases with increasing metal loading, because there are a variety of surface ligands, and because the metal ions bind first to the surface groups with highest affinity and subsequently to groups with lower affinity. A much better fit of the data is obtained if models are used with more than one adjustable constant such as the constant capacitance or the Fowler/Guggenheim/Frumkin model or a two-site Langmuir isotherm. The kinetics of adsorption and uptake of Cu(II) to Chlamydomonas is characterized by the establishment of a relatively fast pseudo-adsorption equilibrium with the surface, followed by slow diffusion-controlled uptake into the inside of the cell. (Author's abstract)
W89-01227

METALLOTHIONEIN-LIKE HEAVY METAL BINDING PROTEIN LEVELS IN ASIATIC CLAMS ARE DEPENDENT ON THE DURATION AND MODE OF EXPOSURE TO CADMIUM,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
F. G. Doherty, M. L. Failla, and D. S. Cherry.
Water Research WATRAG, Vol. 22, No. 7, p 927-932, July 1988. 3 fig, 35 ref.

Descriptors: *Path of pollutants, *Bioassay, *Heavy metals, *Adsorption, *Clams, *Cadmium, *Metallothionein, Animal tissues, Gills, Muscle, Proteins, Correlation analysis.

Tissue concentrations of cadmium and metallothionein-like heavy-metal binding protein (MT-like HMBP) were highly correlated (correlation coefficient = 0.97) during a continuous 30-day exposure of Asiatic clams (Corbicula fluminea) to dissolved Cd (0.10 mg/l). Continuous exposure of Asiatic clams to dissolved Cd (0.10 mg/l) for 30 days in a second study revealed that gills, mantle, and adductor muscles (collectively referred to as GMA) had higher concentrations of Cd and MT-like HMBP than visceral mass of the same organism. Ingestion of Cd-contaminated algae by C. fluminea (4 h/day for 15 days) resulted in higher concentrations of Cd and MT-like HMBP in visceral mass than GMA. These data indicate that the levels of Cd and MT-like HMBP in soft tissues of the Asiatic clam are dependent on the duration and mode of exposure to Cd. (Author's abstract)
W89-01228

FATE AND TRANSPORT OF ORGANICS IN SOIL: MODEL PREDICTIONS AND EXPERIMENTAL RESULTS,
Utah State Univ., Logan. Dept. of Civil Engineering.
B. D. Symons, R. C. Sims, and W. J. Grenney.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 9, p 1684-1693, September 1988. 3 fig, 11 tab, 11 ref.

Descriptors: *Soil contamination, *Fate of pollutants, *Path of pollutants, *Model studies, *Organic compounds, Prediction, Hydrocarbons, Degradation, Biodegradation, Soil columns, Incubation, Sensitivity analysis.

Laboratory batch reactors were used to generate quantitative information about the fate of polynuclear aromatic hydrocarbon (PNA) compounds in soil systems. First-order degradation rates and equilibrium partition coefficients determined in laboratory studies were used in the Vadose Zone Interactive Processes (VIP) mathematical model to predict the fate and behavior of the PNA compounds as a function of time and soil depth. Predicted model results were compared with independent laboratory soil-column studies for model validation. The VIP model provided a good approximation of the degradation and transport of the seven PNA compounds evaluated after 6 months of incubation in soil. Sensitive parameters in the VIP model included degradation rates and initial soil concentrations. (Author's abstract)
W89-01239

FACTORS AFFECTING THE EFFICIENCY OF SOME ESTIMATES OF FLUVIAL TOTAL PHOSPHORUS LOAD,
Clarkson Univ., Potsdam, NY. Dept. of Civil and Environmental Engineering.
T. C. Young, J. V. DePinto, and T. M. Heidtke.
Water Resources Research WRERAO, Vol. 24, No. 9, p 1535-1540, September 1988. 3 fig, 2 tab, 17 ref, append. EPA Grants R005872-01 and R005878-01.

Descriptors: *Rivers, *Nutrients, *Pollution load, *Monte Carlo method, *Phosphorus, Estimation, Flow discharge, Hydrologic data collections, Great Lakes, Simulation, Stratified flow, Least squares method, Regression analysis.

The accuracy of estimating total phosphorus (TP) loads to receiving waters usually is constrained by availability of concentration data, as discharge (flow) data normally are comparatively abundant. Using 4 years of daily observations from three tributaries to the Great Lakes (Grand, Saginaw, and Sandusky Rivers), annual TP loads were tested for accuracy by five methods, including regression, ratio, and robust estimators. Monte-Carlo methods were employed to simulate replicated flow-stratified sampling of the datasets with various allocations of samples to flow strata. Each of the load-calculation methods was applied to each group of simulated samples, and response was quantified as load-estimation error (computed minus 'true' load). The results show the most consistently accurate estimator was Beale's stratified ratio estimator. It was, however, the only stratified estimator tested and should have been more accurate. Most accurate of the unstratified estimators was a straightforward least-squares regression (log-log) method. The response of estimation bias to flow cut point and sample-allocation manipulations indicated (1) beneficial results generally (but not always) obtained from high-flow weighting of sampling and (2) postsampling stratification generally may yield improved accuracy for load estimation and deserves additional research. (Author's abstract)
W89-01249

ATMOSPHERIC DEPOSITION OF POLYCYCLIC AROMATIC HYDROCARBONS TO WATER SURFACES: A MASS BALANCE APPROACH,
Indiana Univ., Bloomington. School of Public and Environmental Affairs.
B. D. McVeety, and R. A. Hites.
Atmospheric Environment ATENBP, Vol. 22, No. 3, p 511-536, March 1988. 10 fig, 8 tab, 76 ref.

Descriptors: *Hydrocarbons, *Polycyclic aromatic hydrocarbons, *Path of pollutants, *Air pollution, *Water pollution sources, Pollutants, Model studies, Mass balance, Lakes, Siskiwit Lake, Lake Superior, Sediments, Rain, Snow, Gas chromatography, Mass spectrometry, Deposition.

A mass balance model was developed to explain the movement of polycyclic aromatic hydrocarbons (PAH) into and out of Siskiwit Lake, which is located on a wilderness island in northern Lake Superior. Because of its location, the PAH found in this lake must have originated exclusively from atmospheric sources. Using gas chromatographic mass spectrometry, 11 PAH were quantified in rain, snow, air, lake water, sediment core and sediment trap samples. From the dry deposition fluxes, an aerosol deposition velocity of 0.99 +/- 0.15 cm/s was calculated for indeno(1,2,3-cd)pyrene and benzo(ghi)perylene, two high molecular weight PAH which are not found in the gas phase. The dry aerosol was found to dominate the wet removal mechanism by a ratio of 9:1. The dry gas flux was negative, indicating that surface volatilization was taking place; it accounted for 10-80% of the total output flux depending on the volatility of the PAH. The remaining PAH were lost to sedimentation. From the dry gas flux, an overall mass transfer coefficient was calculated to be 0.18 +/- 0.06 m/d. In this case, the overall mass transfer is dominated by the liquid phase resistance. (Author's abstract)
W89-01257

NITRATE TRACE DETERMINATIONS IN SNOW AND FIRN CORE SAMPLES OF ICE SHELVES AT THE WEDDELL SEA, ANTARCTICA,
Regensburg Univ. (Germany, F.R.). Inst. fuer Anorganische Chemie.
J. Neubauer, and K. G. Heumann.
Atmospheric Environment ATENBP, Vol. 22, No. 3, p 537-545, March 1988. 5 fig, 3 tab, 37 ref.

Descriptors: *Path of pollutants, *Arctic, *Antarctica, *Nitrate, *Weddell Sea, *Snow sampling, *Firn, Chemistry of precipitation, Seaonal variation, Water pollution, Isotope dilution mass spectroscopy, Ice, Ice shelves, Pollutants, Antarctica, Water pollution sources, Snow.

The definitive method of isotope dilution mass spectrometry was applied to determine nitrate surfaces in surface snow and firn core samples of different ice shelves along the Weddell Sea, West Antarctica and in precipitations near the Antarctic peninsula. Three of a total number of seven depth profiles analyzed showed weak seasonal variations with a trend to nitrate concentration maxima in summer and minima in winter. The average nitrate concentration of the depth profiles down to 220 cm lay in the range of 38-93 ng/g which agrees with other ice shelf analyses. The highest levels in the ice shelf depth profiles are the same as those analyzed at the South Pole.No marine influence has been found for the nitrate concentration in contrast to the situation for chloride. The mean nitrate concentrations in new snow, in old snow and in firn core samples were 176, 107, and 60 ng/g, respectively, indicating a substantial decrease with time. The results clearly demonstrate that a re-emission of HNO3 after deposition in surface snow by evaporation or photochemical decomposition must occur and that there is not a simple correlation between the nitrate concentration in Antarctic snow and in the Antarctic atmosphere. A relatively high nitrate concentration of 266 ng/g was found in a hoar-frost sample. The same range of nitrate concentrations as in surface snow samples was found in precipitations of snow around the Antarctic Peninsula and in precipitations over the South Atlantic at places without substantial anthropogenic influence. A similar nitrate 'background' exists in these regions and, therefore, possibly the same primary source in the troposphere is responsible for these comparable nitrate levels. (Author's abstract)
W89-01258

RELATIVE ROLES OF EMISSIONS CHANGES AND METEOROLOGICAL VARIABILITY OF WET SULFUR DEPOSITION: A TRAJECTORY MODEL STUDY,
Ontario Ministry of the Environment, Toronto. Air Resources Branch.
G. Ellenton, P. K. Misra, and B. Ley.
Atmospheric Environment ATENBP, Vol. 22, No. 3, p 547-556, March 1988. 7 fig, 3 tab, 22 ref, append.

Descriptors: *Water pollution sources, *Sulfur, *Model studies, *Acid rain, Seasonal variation, Air pollution, Pollutants, Transport, Paths of pollutants, Deposition.

Wet deposition of sulfur oxides in eastern North America has been computed on a monthly time scale for 3 years, 1978-1980, using a Lagrangian trajectory model of long-range atmospheric transport in which wind flow and precipitation were determined from routine surface meteorological observations. Comparison between total monthly wet deposition of sulfur measured at 11 sampling locations from three monitoring networks in Ontario and neighboring states and the estimated wet deposition showed that the observed seasonal variation is simulated well by the model. Based on a sample of 177 paired monthly data points an r squared = 0.5 was obtained and linear regression yielded a slope of 0.99 and intercept of 6.1 mg SO4(--) per month. This demonstrates the strong meteorological influence on the monthly variability of wet deposition, since model emissions were annual values. In a controlled model experiment the effects of meteorological variability which could obscure the effects of emission reduction were removed. A reduction of 4.8% in the 1980 eastern North American sulfur emissions was simulated by turning off one large source. This test resulted in estimated reductions of annually averaged sulfur wet deposition of between 15 and 1% for stations separated from the source by 150-600 km. (Author's abstract)
W89-01259

ASPECTS OF ATMOSPHERIC POLLUTANT ORIGIN AND DEPOSITION REVEALED BY MULTIELEMENTAL OBSERVATIONS AT A RURAL LOCATION IN EASTERN CANADA,
Atmospheric Environment Service, Downsview (Ontario).
L. A. Barrie.
Journal of Geophysical Research (D) JGRDE3, Vol. 93, No. 4, p 3773-3788, April 20, 1988. 8 fig, 7 tab, 28 ref.

Descriptors: *Water pollution sources, *Air pollution, *Aerosols, *Deposition, Pollutants, Watersheds, Ontario, Canada, Sampling, Heavy Metals, Neutron activation, X-ray fluorescence, Plasma emission spectroscopy, Metals.

During autumn 1984, at a location in central Ontario, a study of the elemental composition of aerosols and precipitation was undertaken to determine the feasibility of making daily multielemental measurements on a routine basis, in order to probe the potential for gaining insight into pollutant origin from multielemental composition, and to estimate trace element deposition to an acid-sensitive watershed. The concentrations of Ti, Br, Mn, In, Na, V, Al, Ca, Se, As, Sb, Pb, Fe, Mg, Cu, Zn, and Cd in aerosol and of Pb, Mg, Ca, Br, As, I, Mn, and V in precipitation were measurable routinely, using neutron activation, X ray fluorescence, and plasma emission spectroscopy. Standard high volume samplers for total aerosols below 15 micrometer diameter as well a dichotomous samplers and Andersen impactors for size fractionation were operated simultaneously with two wet-only precipitation collectors. Aerosol data revealed four components: one soil (Mg-Ti-Al=Ca-Fe) and three anthropogenic (Se-Sb-Pb-Cd-Br; Mass-Cu-SO4(--);In-As). Ranked in order of increasing mass fraction in 2.1 to 10 micrometer diameter particles are the elements Pb, S, Se, Br, As, Cl, Na, V, In, Cu, Mn, Al, Ba, Ti, and Ca. A comparison of air parcel origin on high and low-concentration days, using 3-day back trajectories, revealed major source regions of SO4(--), Pb, In, As, and Al. The element In is an excellent tracer of smelter emissions to the north. Although the estimated mean ratio of In/Se in smelter emissions from central Ontario is close to that used in the regional aerosol apportionment model of Rahn and Lowenthal, its variability is greater than they propose. In 21 precipitation events, strong correlations were found between H(+) - SO4(--), Ca(++) - Mg(++), NO3(-) - NH4(+) - Cl(-) - V, and Pb - Br. The mass ratio of Br/Pb was higher in precipitation (0.47) than in aerosols (0.27), possibly because of precipitation scavenging of HBr gas in addition to Br in aerosols. In ascending order the estimated dry-deposited fraction of total deposition of Br, Pb, Mg, Mn, Ca, S, V, and As ranged from 10 to 42%. (Author's abstract)
W89-01264

5C. Effects Of Pollution

AVAILABILITY OF PHOSPHORUS SOURCES FOR BLOOMS OF PHAEOCYSTIS POUCHETII (HAPTOPHYCEAE) IN THE NORTH SEA: IMPACT OF THE RIVER RHINE,
Nederlands Inst. voor Onderzoek der Zee, Texel.
For primary bibliographic entry see Field 2L.
W89-00004

FRESHWATER MOLLUSKS AS INDICATORS OF TROPHIC CONDITIONS IN COASTAL LAKES OF SOUTHERN BRAZIL (MOLUSCOS DULCEAQUICOLAS COMO INDICADORES DE CONDICOES TROFICAS EM LAGOAS COSTEIRAS DO SUL DO BRASIL),
Universitaet des Saarlandes, Saarbruecken (Germany, F.R.). Inst. fuer Biogeographie.
For primary bibliographic entry see Field 5A.
W89-00008

SCIENTIFIC CONCEPTS AND METHODOLOGIES PERTINENT TO LAKE RESEARCH AND LAKE RESTORATION,
National Water Research Inst., Burlington (Ontario).
For primary bibliographic entry see Field 2H.
W89-00013

BACKGROUND ASPECTS OF LAKE RESTORATION: WATER BALANCE, HEAVY METAL CONTENT, PHOSPHORUS HOMEOSTASIS,
Northwestern Univ., Evanston, IL. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2H.
W89-00014

LAKE RESTORATION: WHY OXYGENATION AND ARTIFICIAL MIXING CANNOT SUBSTITUTE FOR A DECREASE IN THE EXTERNAL PHOSPHORUS LOADING,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
For primary bibliographic entry see Field 5G.
W89-00015

STRATEGIES OF LAKE SANITATION,
Wahnbachtalsperrenverband, Siegburg (Germany, F.R.).
For primary bibliographic entry see Field 5G.
W89-00017

RESPONSE OF PHYTOPLANKTON COMMUNITIES TO CHANGING LAKE ENVIRONMENTS,
Freshwater Biological Association, Windermere (England).
For primary bibliographic entry see Field 2H.
W89-00018

FOOD WEB MANIPULATION WITHOUT NUTRIENT CONTROL: A USEFUL STRATEGY IN LAKE RESTORATION,
Technische Univ., Dresden (German D.R.). Sektion Wasserwesen.
For primary bibliographic entry see Field 5G.
W89-00019

TUMOR FREQUENCIES AND CONTAMINANT CONCENTRATIONS IN BROWN BULLHEADS FROM AN INDUSTRIALIZED RIVER AND A RECREATIONAL LAKE,
National Fisheries Contaminant Research Center, Columbus, OH. Field Research Station.
P. C. Baumann, W. D. Smith, and W. K. Parland.
Transactions of the American Fisheries Society TAFSA I, Vol. 116, No. 1, p 79-86, January 1987. 4 fig, 2 tab, 35 ref.

Descriptors: *Fish diseases, *Tumors, *Carcinogens, *Water pollution effects, *Hydrocarbons, *Aromatic compounds, *Lakes, Bullhead, Benzanthracene, Benzopyrene, Liver, Skin, Seasonal variation, Black River, Buckeye Lake, Ohio, Contamination, Pollutants, Industrial wastewater.

Frequencies of external and grossly visible liver tumors were high in brown bullheads Ictalurus nebulosus from Black River, an industrialized Lake Erie tributary. Skin and liver tumors were lacking in fish from Buckeye Lake, a reference site, and the incidence of lip tumors was low (<2%). Liver tumors, primarily cholangiocarcinomas, increased significantly ($P<0.05$) with age in Black River brown bullheads, occurring in 28-44% of the 4-year-old fish collected in 1980-82. External tumors did not increase consistently with age. Within year classes, the occurrence of grossly observable liver tumors was higher in fall than in spring. Liver tumor incidence was not correlated with sex. Organic contaminants were higher in brown bull-

heads from the Black River than in those from Buckeye Lake. Polynuclear aromatic hydrocarbons were particularly high, including carcinogens such as benz(a)anthracene and benzo(a)pyrene (B(a)P). Limited electron microscopy of cholangiocarcinomas provided no evidence of virus. Since brown bullhead have the ability to hepatically activate B(a)P, and since B(a)P has been shown to induce cancer in fish, the hypothesis of a chemical etiology for the tumors in the Black River fish best fits the available data. (Author's abstract)
W89-00028

LONGITUDINAL CHANGES IN FISH ASSEMBLAGES AND WATER QUALITY IN THE WILLAMETTE RIVER, OREGON,
Northrop Services, Inc., Corvallis, OR.
For primary bibliographic entry see Field 2H.
W89-00029

EUTROPHICATION EFFECTS OF PREY SIZE AND FOOD AVAILABLE TO YELLOW PERCH IN LAKE ERIE,
Ohio Cooperative Fishery Research Unit, Columbus.
R. S. Hayward, and F. J. Margraf.
Transactions of the American Fisheries Society TAFSA I, Vol. 116, No. 2, p 210-223, March 1987. 11 fig, 1 tab, 65 ref. Federal Aid in Fish Restoration, Project F-35-R, Study 6, and Commercial Fisheries Research and Development, Project 3-379-R, Study 1.

Descriptors: *Lake Erie, *Model studies, *Eutrophication, *Eutrophic lakes, *Fish, Perch, Growth, Fish food, Bioenergetics modeling, Temperature, Lake aging, Limnology.

Before 1970, yellow perch Perca flavescens grew at similar rates in Lake Erie's western and central basins. At that time, high rates of nutrient loading were causing rapid eutrophication in both areas so that by the mid-1970s the central basin had become mildly eutrophic while the shallow western basin had reached hypereutrophy. From 1970 to 1983, growth rates of yellow perch in the western basin declined sharply while growth rates increased moderately in the central basin. Modeling of bioenergetics suggests that present differences in growth rates are due to interbasin differences in food supply and not to temperature. Direct estimation of feeding rates in each basin in 1983 supports this inference. Food limitation in the western basin appears related to a reduced size structure of benthic prey associated with advanced eutrophy. In the central basin, larger benthic prey are available and food consumption rates by yellow perch are high. Food limitation is more serious for larger than for smaller perch in the western basin, and this has apparently caused stunting and population degradation. Further evidence from the literature suggests that changes in prey size structure which accompany eutrophication may be a primary cause of the succession of fish species that occurs as lakes age. Mechanistic understanding of this succession will enhance present capacity to predict fish community responses both to ongoing eutrophication and to the more recent oligotrophication of lakes. (Author's abstract)
W89-00030

FEEDBACK DEPENDENCE BETWEEN THE EUTROPHICATION PROCESS AND CHANGES IN THE FISH COMMUNITY: THE THEORY OF ICHTHYOEUTROPHICATION (SPRZEZENIE ZWROTHE MIEDZY PROCESUM EUTROFIZACJI A ZMIANAMI ZESPOLU RYB. TESRI ICHTIOEUTROFIZACJI),
Instytut Rybactwa Srodladowego, Piaseczno (Poland). Zabieniec Centre.
K. Opuszynski.
Wiadomosci Ekologiczne WEKLAP, Vol. 33, No. 1, p 21-30, 1987. 1 fig, 35 ref. English summary.

Descriptors: *Limnology, *Eutrophication, *Eutrophic lakes, *Fisheries, *Lake fisheries, *Fish conservation, *Environmental protection, Ichthyoeutrophication, Salmon, Carp, Pike, Perch, Endangered species, Ecosystems.

Two separate sets of data on lake eutrophication that have been collected by many investigators, i.e. data on the effect of fish on the ecosystem and data on changes in the fish community caused by the ecosystem changes, have led to a theory called the 'theory of ichthyoeutrophication.' This theory assumes than an interdependence based on the feedback mechanism exists between environmental changes and fish community changes within a water body; the former influence the latter, which in turn speed up the former again. This theory introduces new factors into the philosophy of environmental protection and conservation of endangered species. The conventional augument has been that waters must be kept clean in order to conserve fish. The implication of the new theory is that conserving the fish is one way of counteracting eutrophication. Fishery efforts aimed at counteracting the eutrophication processes should consist of complex measures applied in order to maintain the primary structure of the fish community, with special attention being paid to protection of the piscivorous fish. (Author's abstract)
W89-00031

TRACE ELEMENT CONTENT IN DRINKING WATER OF NASOPHARYNGEAL CARCINOMA PATIENTS,
Hunan Medical Coll., Changsha (China). Dept. of Environmental Medicine.
L. Xia, S. Liang, J. Jiang, X. Zhou, and J. Li.
Cancer Letters CALEDQ, Vol. 41, No. 1, p 91-97, July 1988. 4 tab, 15 ref.

Descriptors: *Trace elements, *Carcinogens, *Cancer, *Water pollution effects, *Drinking water, *Human diseases, Population exposure, China, Potable water, Public health, Water analysis, Nickel, Heavy metals, Morbidity, Hydrogen ion concentration.

Chinese in the Xiangxi region of Hunan province in China have a high incidence of nasopharyngeal carcinoma (NPC). For analyzing the relation between NPC and trace elements, the concentrations of 7 trace elements in drinking water (well water) of high- and low- incidence areas were measured (75 samples). The results showed that the concentrations of Ni, Zn and Cd in drinking water of high-incidence areas were significantly higher than those in low incidence areas. Especially, the Ni level in drinking water had a significant positive correlation with NPC mortality. These observations are consistent with earlier studies. A highly positive correlation was also found between Ni/pH value in drinking water and NPC mortality. This suggests that only considering the ion concentration in drinking water is not enough; The pH of the drinking water should also be considered when the relation between NPC and trace elements is studied. Because th pH of the medium can strongly affect trace element chemical characteristics and its metabolic state in living systems, the M/pH (M, metal concentration) may be an important factor worthy of further research. (Author's abstract)
W89-00048

EFFECT OF A HEATED WASTEWATER DISCHARGE UPON RIVER PROTOZOAN SPECIES POOL VARIABILITY THROUGH TIME AND SPACE,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
J. Cairns, and R. L. Kaesler.
Revista de Biologia RVBIAP, Vol. 13, No. 1-4, p 3-12, 1986. 6 fig, 5 ref.

Descriptors: *Temperature effects, *Heated water, *Protozoa, *Species composition, *Environmental effects, *Water pollution effects, Aquatic animals, Rivers, Savannah River, Savannah River Plant, Thermal pollution, Cluster analysis, Distribution, Spatial distribution, Temporal distribution, Environment, Aquatic environment, Ecology.

Data collected from 1951 to 1974 on the protozoan communities of the Savannah River were analyzed to determine whether the slight heating by thermal discharges from the Savannah River Plant had any effect on the similarity of samples as shown by clustering patterns of protozoans. Four major conclusions were reached: (1) cluster analysis indicates that the thermal discharges entering the river between stations had little effect on the types of species present; (2) similarities between samples were quite low (0.39), indicating that there was not a substantial repetition of occurrence of species from station to station or from year to year; (3) there is no tendency for samples from the same station to be similar from year to year; and (4) the similarity of samples within some years was so strong that in some instances all six samples from a given year (spring and fall) form a cluster, whereas, in other instances, different samples from the same year show little similarity. Therefore, the heated wastewater discharge seems to have had no major effect upon the types of protozoan species present, since otherwise samples from years in which discharges occurred would have been in different clusters from those in which there was no heated wastewater added to the river. (Author's abstract)
W89-00077

STUDY OF THE TEMPERATURE DEPENDENCE OF THE ACUTE TOXICITY OF PENTACHLOROPHENOL TO A FRESHWATER POND SNAIL, VIVIPARUS BENGALENSIS L.,
K.L.D.A.V. Coll., Roorkee (India). Dept. of Zoology.
P. K. Gupta, and V. S. Durve.
Revista de Biologia RVBIAP, Vol. 13, No. 1-4, p 103-112, 1986. 8 tab, 20 ref.

Descriptors: *Toxicity, *Pentachlorophenol, *Snails, *Water pollution effects, *Temperature effects, Pesticide toxicity, Ponds, Mollusks, Bioassay, Assay, Chlorinated hydrocarbons.

Static bioassay tests with pentachlorophenol (PCP) were conducted in the laboratory with the freshwater pond snail Viviparus bengalensis L. at different environmental temperatures. The 96-hr LC50 in mg/l of PCP were 1.480 (1.366-1.594) at 19 C, 0.644 (0.543-0.745) at 27 C, 1.390 (1.285-1.495) at 32 C, and 0.842 (0.788-0.906) at 30 C. Results reveal that the temperature was, to some extent, the controlling factor in pentachlorophenol toxicity to the snail. (Author's abstract)
W89-00078

PESTICIDAL EFFECTS ON CHIRONOMID LARVAE,
Udaipur Univ. (India). Dept. of Limnology and Fisheries.
H. K. Vardia, and P. S. Rao.
Revista de Biologia RVBIAP, Vol. 13, No. 1-4, p 113-115, 1986. 1 tab, 17 ref.

Descriptors: *Pesticide toxicity, *Midges, *Benthic environment, *Water pollution effects, Growth stages, Larval growth stage, Fish food, Fish food organisms, Herbicides, Insecticides, Fungicides, Environment, Benthic fauna, Benthos, Fauna, Toxicity, 2,4-D, Fernanoxone, Monoson, Difolation.

Chironomid larvae, an important fish food, were bioassayed by static toxicological methods in hard waters (180 mg/L as CaCO3). Third instar midges were exposed to four pesticides. The toxicity rating was 2,4-D > monoson > difolaton > fernanoxone. Herbicide 2,4-D and fernanoxone have shown wide differences in potencies (12 hr LC50 21.3 and 991.4 mg/L, respectively), when 2,4-D was technical grade and fernanoxone commercial grade. Insecticide monoson and fungicide difolaton proved to be moderately toxic (12 hr LC50 92.2 and 157.3 mg/L, respectively). The variations in relative toxicity increased in the case of fernanoxone with duration of exposure. First instar seems to be more sensitive, and hence work is in progress on them. Use of chironomid larvae as a model for short-term toxicological tests also is discussed. (Author's abstract)
W89-00079

INFLUENCE OF DUSTS FROM CHOSEN INDUSTRIAL PLANTS ON PARTICULAR LINKS OF FOREST ECOSYSTEM OF THE NIEPOLOMICE FOREST,

Akademia Rolnicza, Krakow (Poland). Faculty of Forestry.
J. Greszta, S. Braniewski, E. Chrzanowska, A. Nosek, and J. Chlodny.
Ekologia Polska ELPLBS, Vol. 35, No. 2, p 291-326, 1987. 17 fig, 3 tab, 27 ref.

Descriptors: *Poland, *Dusts, *Air pollution effects, *Heavy metals, *Forests, *Environmental effects, Industrial plants, Path of pollutants, Niepolomice Forest, Canopy, Zinc, Cadmium, Aluminum, Iron, Mineral industry, Powerplants, Chemical industry, Ecological effects, Vegetation effects, Environment, Coniferous forests, Mixed forests, Microbiological studies, Water analysis, Bacterial analysis, Chemical analysis, Enzymes, Insects, Pine trees.

An experiment was carried out to study the toxic effect of dusts from electrofilters of industrial plants. The dusts were taken from zinc, cadmium, aluminum, and iron plants, an electric power station, and a cement plant. They were introduced under the stand canopy of the Niepolomice Forest (Poland) in the following concentrations: 100, 500, 1,000, 2,000, and 5,000 t/sq km per year. It was found that the character of the groundwaters changed and their electrolytic conductivity increased considerably, especially in the case of dusts from cadmium and aluminum plants. The increase in conductivity in response to cadmium and aluminum dusts decreased considerably when the dusts were no longer introduced, whereas with zinc dusts the conductivity remained high for a few years after their introduction. Dusts from zinc, cadmium, and aluminum plants had a toxic effect on the forest ecosystem, independently of dose, while other dusts had a stimulating effect. The toxic dusts caused a decrease in the number of plants, both lower and higher, and inhibited the enzymatic activity of soils, as well as cellulose decomposition, respiration, ammonification, and nitrification. Plants with a shallow root system disappeared first, whereas plants with deep roots survived the experiment or reacted to the dusts with a 1 to 3 year delay. (Doria-PTT)
W89-00081

BIOCHEMICAL CHANGES IN THE LIVER OF FISH, TILAPIA MOSSAMBICA (PETERS), DURING CONTINUOUS EXPOSURE TO MONOCROTOPHOS,
Baroda Univ. (India). Dept. of Zoology.
U. M. Joshi, and A. K. Desai.
Ecotoxicology and Environmental Safety EESADV, Vol. 15, No. 3, p 272-276, June 1988. 2 tab, 21 ref.

Descriptors: *Tilapia, *Toxicity, *Pesticide toxicity, *Fish, *Liver, Pesticides, Organophosphorus pesticides, Water pollution effects, Insecticides, Tissue analysis, Proteins, Enzymes, Animal physiology, Fish physiology, Pathology, Animal pathology.

The effect of continuous exposure to the organophosphate insecticide monocrotophos at 2.5 ppm was determined over a period of 2 through 45 days on protein, RNA, and DNA contents and on 5'-nucleotidase activity in the liver of Tilapia mossambica. Protein content was decreased by 45% after 5 days, returned to control levels at 10-30 days, and again decreased by 45 days. DNA content was decreased by 2 days, returned to control values by 5 days, and remained constant throughout the exposure. RNA content was significantly lower starting from 2 through 45 days of exposure. 5'-Nucleotidase activity showed a transient increase at 5 and 30 days of monocrotophos exposure. Results indicate that monocrotophos altered the protein, DNA, and RNA contents and the 5'-nucleotidase activity levels as early as 2 and 5 days. However, these changes were reversed by 10 days and the alterations reappeared after a short period of recovery. This supports earlier histological observations of hepatic pathology during monocrotophos exposure. (Author's abstract)
W89-00085

TOXICITY BIOASSAY OF TECHNICAL AND COMMERCIAL FORMULATIONS OF CARBARYL TO THE FRESHWATER CATFISH, CLARIAS BATRACHUS,
Banaras Hindu Univ., Varanasi (India). Dept. of Zoology.
G. Tripathi, and S. P. Shukla.
Ecotoxicology and Environmental Safety EESADV, Vol. 15, No. 3, p 277-281, June 1988. 2 fig, 1 tab, 13 ref.

Descriptors: *Toxicity, *Pesticide toxicity, *Carbamate pesticides, *Fish, *Catfish, *Bioassay, Pesticides, Assay, Mortality, Water pollution effects, Insecticides, Adapatation.

The acute toxicity of carbaryl in technical and commercial formulations was investigated in the freshwater catfish, Clarias batrachus, after exposures of 24, 48, 72, and 96 hr. The 'trimmed Spearman-Karber method' with 10% trimming was employed for the determination of median lethal concentration (LC(I)50). The LC(I)50 values of the commercial carbaryl decreased gradually with increase of exposure duration from 24 to 96 hr. The LC(I)50 values of technical grade carbaryl also decreased with increasing length of exposure. This reflects a time-dependent adaptability of the fish to the pesticide. Further, the technical grade compound was 2.5 times more toxic than the commercial preparation. Results demonstrate the involvement of carbaryl rather than the additive substances as the active principle in acute toxicity testing. Dermal desquamation was found to be a characteristic change in response to carbaryl exposure. (Author's abstract)
W89-00086

ACCLIMATIZATION OF ROACH, RUTILUS RUTILUS (L.), TO TOXIC COMPONENTS OF KRAFT PULP MILL EFFLUENTS,
Joensuu Univ. (Finland). Dept. of Biology.
A. Oikari, and J. Kukkonen.
Ecotoxicology and Environmental Safety EESADV, Vol. 15, No. 3, p 282-288, June 1988. 3 fig, 24 ref. Academy of Finland/Research Council for the Environmental Sciences Project 06/085.

Descriptors: *Acclimatization, *Fish, *Roach, *Pulp wastes, *Bioaccumulation, Wastes, Industrial wastes, Pulp and paper industry, Accumulation, Growth, Phenols, Tissue analysis, Fate of pollutants, Adaptation.

Roach (Rutilus rutilus) were exposed to a simulated bleached kraft mill effluent (KME-Sa+CP) for 38 days at a concentration of 0.035 x LC50 and again for 14 days at 0.07 x LC50. During the experiment, their tolerances to KME-Sa+CP were tested five times by measuring the 48-hr LC50 values. The growth of roach was also monitored. At the end of the exposure, accumulation of (C14)pentachlorophenol in various parts of the fish (total PCP in water 15.6 micrograms/l) was measured. When the fish were preexposed to KME-Sa+CP, the acute tolerance of this mixture in roach increased by 30-39%, but the response was abolished in 31 days. Fish growth remained unchanged during the experiment. Measurement of PCP accumulation revealed no difference in the absorption rate, but under steady-state conditions the degree of bioconcentration was 16% lower in preexposed roach than in unexposed controls. This difference was entirely accounted for in the head and visceral parts of the fish. Even when no final changes were noted in tolerance and growth rate of the fish, it is suggested that the significantly lowered body burden implies acclimatizatory compensation under subchronic exposure of this xenobiotic. (Author's abstract)
W89-00087

HEAVY-METAL TOXICITY IN THE CYANOBACTERIUM NOSTOC LINCKIA,
Banaras Hindu Univ., Varanasi (India). Centre for Advanced Study in Botany.
D. Kumar, M. Jha, and H. D. Kumar.
Aquatic Botany AQBODS, Vol. 22, No. 2, p 101-105, July 1985. 2 tab, 9 ref.

Descriptors: *Water pollution effects, *Heavy metals, *Toxicity, *India, *Ganges River, *Cyanophyta, *Nostoc, Mercury, Nickel, Cobalt, Wastewater disposal, Industrial wastes, Nitrogen fixation, Bioindicators.

The effects of mercuric chloride, nickel chloride, and cobalt chloride were studied in Nostoc linckia, an important component of the ecosystem of the river Ganges (which receives effluents from the Varanasi sewage disposal plant and the Ramnagar Industrial Estate). Although the level of heavy metals in the Ganges is high, it does not seem to be affecting the biological community structure significantly; however, proposed metal-plating and glass factories will increase metal concentrations in the river ecosystem some 5 to 10-fold. If nitrogen-fixing species are more sensitive than those which are not nitrogen-fixers, their disappearance could trigger large changes in species successions. N. linckia was isolated from the river and grown axenically in Allen and Arnon's medium, adjusted to pH 7.5. Low-level (0.2 ppm) applications of mercuric chloride increased heterocyst frequency, stimulated nitrate reductase and ammonium uptake, but significantly inhibited acetylene-reducing and glutamine-synthetase activities. In contrast, nickel and cobalt chlorides greatly inhibited all of the above processes. All three heavy metals studied had more or less similar patterns of inhibition on the physiological processes studied but differed in their toxicity in the order: Hg > Ni > Co. The sensitivity of this alga to heavy metals argues for its use as a pollution indicator. (Shidler-PTT)
W89-00094

PHOTOSYNTHESIS OF SUBMERSED MACROPHYTES IN ACIDIFIED LAKES: II. CARBON LIMITATION AND UTILIZATION OF BENTHIC CO2 SOURCES,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
R. G. Wetzel, E. S. Brammer, K. Lindstrom, and C. Forsberg.
Aquatic Botany AQBODS, Vol. 22, No. 2, p 107-120, July 1985. 5 fig, 2 tab, 32 ref. Swedish National Science Research Council Subvention O-TE 2682-106 and Department of Energy Subventions EY-76-S-02-1599 and COO-1599-246.

Descriptors: *Water pollution effects, *Acid rain, *Lakes, *Photosynthesis, *Submerged plants, *Limiting nutrients, *Carbon dioxide, Macrophytes, Acidic water, Carbon, Benthic environment, Plant physiology, Plant tissues, Leaves, Rhizosphere, Light quality, Bacteria, Organic compounds, Sediment-water interfaces, Respiration.

Photosynthetic characteristics of carbon-dioxide limitations were analyzed for leaf tissue in a Cartesian-diver system, and with whole plants in electrode macrosystems for submersed macrophytes (Juncus bulbosus, Sphagnum auriculatum var. inundatum) and other benthic moss and algae (Drepanocladus, Batrachospermum, and an algal mat) from acidified lakes. Light compensation points were extremely low for Juncus and Sphagnum, and higher for the shallow-living Batrachospermum. Leaf tissue, whole plants, and algal populations were rapidly limited by carbon-dioxide availability under closed, submersed, acidified conditions (pH 4 to 6). Controlled and in-situ experiments were performed, in which the rooting tissue of J. bulbosus was partitioned from the leaves and the rates of photosynthetic carbon fixation of the foliage were analyzed under different conditions of carbon-dioxide enhancement in the rhizosphere of the sediments. From 25 to 40% of the carbon fixed in the leaves can originate from the rhizosphere, diffuse to the leaves via internal gas lacunae, and be fixed photosynthetically. Photosynthetic utilization of carbon dioxide from the water surrounding the leaves was reduced markedly when the carbon-dioxide concentration of the rhizosphere was increased by direct additions of carbon dioxide, bacteria, or organic compounds (glucose, acetate) that stimulate bacterial growth. Shifts to predominance of submersed benthic primary producers which have low light-compensation points and are adapted to acidified lakes are related to circumvention of carbon limitation in the water by utilization of enhanced carbon-dioxide availability in the rhizosphere and at the sediment-water interface from bacterial degradation of organic matter. They are

also related to physiological mechanisms that conserve and recycle carbon dioxide of respiration and photorespiration. (Author's abstract)
W89-00095

EFFECTS OF THE SEASON AND OF WATER CHEMISTRY ON THE DECOMPOSITION OF NYMPHAEA ALBA L.: WEIGHT LOSS AND PYROLYSIS MASS SPECTROMETRY OF THE PARTICULATE MATTER,
Katholieke Univ. Nijmegen (Netherlands). Lab. of Aquatic Ecology.
For primary bibliographic entry see Field 2H.
W89-00096

LEAF PRODUCTION AND NITROGEN AND PHOSPHORUS TISSUE CONTENT OF LITTORELLA UNIFLORA (L.) ASCHERS. IN RELATION TO NITROGEN AND PHOSPHORUS ENRICHMENT OF THE SEDIMENT IN OLIGOTROPHIC LAKE HAMPEN, DENMARK,
Aarhus Univ. (Denmark). Botanical Inst.
R. Christiansen, N. J. Skovmand Friis, and M. Sondergaard.
Aquatic Botany AQBODS, Vol. 23, No. 1, p 1-11, October 1985. 3 fig, 3 tab, 34 ref.

Descriptors: *Water pollution effects, *Lake sediments, *Aquatic plants, *Plant growth, *Nitrogen, *Phosphorus, Tissue analysis, Oligotrophic lakes, Littorella, Littoral environment, Aquatic soils, Plant tissues, Roots, Vascular tissues, Inorganic compounds, Plant morphology, Plant physiology, Denmark, Lakes, Nutrients, Enrichment, Leaves.

Littoral sediments with a dense population of Littorella uniflora were artificially enriched with nitrogen and phosphorus. Leaf production and tissue nutrient content in response to increasing levels of nutrients were recorded. Phosphorus enrichment resulted in increasing P concentrations in all plant fractions (leaves, stem, and roots), whereas only leaves and roots showed increasing N concentrations when inorganic N was added. Leaf production increased significantly after increasing the sediment P level 2, 3, and 5 times. Nitrogen did not affect leaf production. The tissue content of total N and P in control plants averaged 3.29 and 0.28%, respectively. Thus the critical P level in L. uniflora seems to be about 0.28%, which is higher than previously published values. It was also found that L. uniflora translocates phosphorus from old to younger leaves. (Author's abstract)
W89-00101

RICHNESS OF AQUATIC MACROPHYTE FLORAS OF SOFT WATER LAKES OF DIFFERING PH AND TRACE METAL CONTENT IN ONTARIO, CANADA,
Ontario Ministry of the Environment, Dorchester. Dorset Research Center.
N. D. Yan, G. E. Miller, I. Wile, and G. G. Hitchin.
Aquatic Botany AQBODS, Vol. 23, No. 1, p 27-40, October 1985. 3 fig, 2 tab, 43 ref.

Descriptors: *Water pollution effects, *Acid rain, *Lakes, *Species diversity, *Trace metals, *Aquatic plants, Macrophytes, Acidic water, Hydrogen ion concentration, Copper, Nickel, Phytoplankton, Zooplankton, Macroinvertebrates, Fish, Ontario, Canada.

The total number of macrophyte species was assessed in 39 lakes in central Ontario. The copper and nickel concentrations and pH of the lakes ranged from 1 to 360 mg/cu m, 2 to 3700 mg/cu m, and 3.9 to 7.0, respectively. Two non-exclusive subsets of the data were examined to determine (1), if floral richness was related to lake pH in lakes with low Cu and Ni levels (Dataset I) and (2), if floral richness in acidic (pH < or = 5.3) lakes was related to levels of various trace metals (Dataset II). Charophytes were not found in lakes with pH < 5.2. In Dataset I, there was no relationship between the richness of tracheophytes and pH, and there was a negative relationship between pH and bryophyte richness. Unlike phytoplankton, zooplankton, benthic macroinvertebrates, and fish, there was no decrease in total species richness in lakes of pH < 5.5, as long as trace-metal levels were low. Examination of Dataset II indicated tracheophyte richness of acidic lakes was negatively correlated with Cu and Ni levels. Biological surveys of metal-contaminated acidic lakes are, therefore, not of use for predicting the effects of acid deposition alone on aquatic macrophytes. (Author's abstract)
W89-00103

AMMONIUM AND NITRATE UPTAKE BY AQUATIC PLANTS FROM POORLY BUFFERED AND ACIDIFIED WATERS,
Katholieke Univ. Nijmegen (Netherlands). Lab. of Aquatic Ecology.
J. A. A. R. Schuurkes, C. J. Kok, and C. den Hartog.
Aquatic Botany AQBODS, Vol. 24, No. 2, p 131-146, May 1986. 6 fig, 30 ref.

Descriptors: *Water pollution effects, *Acid rain, *Ammonium, *Nitrates, *Aquatic plants, Acidic water, Ammonium compounds, Oligotrophy, Nitrogen, Enrichment, Plant populations, Aquatic environment, Roots, Leaves, Juncus, Sphagnum, Netherlands, Absorption.

In the Netherlands, atmospheric deposition of ammonia compounds, particularly ammonium sulfate, is an important source for the acidification of oligotrophic soft waters. As a consequence, the acidified waters are generally nitrogen-enriched, ammonium being the dominant N form. How this alteration in the nitrogen condition affects the aquatic plant communities in acidifying waters was examined. The uptake of ammonium and nitrate by leaves and roots of two groups of freshwater plants was studied using glass incubation chambers. The first group (Littorella uniflora, Lobelia dortmanna, Luronium natans, Echinodorus ranunculoides) is characteristic of nitrogen-poor soft waters, whereas the second group (Juncus bulbosus, Sphagnum flexuosum, Agrostis canina, Drepanocladus fluitans) often occurs in dense stands in nitrogen-enriched, acid waters. Both groups have typical adaptations to the nitrogen condition of their aquatic environment. The soft-water species showed a nitrate-dominated (63-73%) nitrogen utilization, with the roots as the major (83%) uptake site. Moreover, they were able to survive at very low nitrogen concentrations. The acid-tolerant species had an ammonium-dominated (85-90%) nitrogen utilization, with the leaves as the major (71-82%) uptake site. This group profits from the increased ammonium levels in acid waters. It was concluded that in the case of acidification increased ammonium concentrations additionally accounted for the suppression of typical soft-water communities by communities dominated by Juncus bulbosus and Sphagnum spp. (Author's abstract)
W89-00112

LOSS OF SEAGRASS IN COCKBURN SOUND, WESTERN AUSTRALIA: II. POSSIBLE CAUSES OF SEAGRASS DECLINE,
Western Australia Univ., Nedlands. Dept. of Botany.
M. L. Cambridge, A. W. Chiffings, C. Brittan, L. Moore, and A. J. McComb.
Aquatic Botany AQBODS, Vol. 24, No. 3, p 269-285, June 1986. 5 fig, 5 tab, 38 ref.

Descriptors: *Water pollution effects, *Coastal waters, *Sea grasses, *Industrial wastes, *Eutrophication, *Epiphytes, Nutrients, Physical properties, Pathogens, Echinoderms, Light penetration, Western Australia, Mortality.

Reasons for an extensive seagrass loss following industrial development were examined. Transplanted seedlings survived poorly in Cockburn Sound, Australia compared with an adjoining embayment. Altered temperature, salinity, sedimentation, and water movement do not explain the death of seagrass over wide areas, and there is no evidence for a role of pathogens. Oil refinery effluent reduced seagrass growth in aquaria at concentrations similar to those at the point of discharge, but could not account for the widespread deterioration observed in the field. Severe grazing by sea urchins was observed on meadows already under stress and does not appear to be a primary cause of decline; caged, transplanted seedlings also deteriorated. Increased light attenuation by phytoplankton blooms may have affected the depth to which seagrasses could survive, but would have had little significant effect in shallow water; marked phytoplankton blooms were recorded only after extensive seagrass decline had taken place. Light reduction by enhanced growth of epiphytes and loosely lying blankets of filamentous algae in nutrient-enriched waters is suggested as the most likely cause of decline. Heavy epiphyte fouling was constantly observed on seagrasses in deteriorating meadows, as well as on declining, transplanted seedlings, and is known to significantly impair photosynthesis in other systems. Extensive seagrass decline coincided with the discharge of effluents rich in plant nutrients. (Author's abstract)
W89-00116

EFFECTS OF LIGHT INTENSITY ON GROWTH OF AZOLLA PINNATA CULTURED IN EFFLUENT COLLECTED FROM THE BANKA STREAM IN WEST BENGAL, INDIA,
Burdwan Univ. (India). Dept. of Botany.
A. Sarkar.
Aquatic Botany AQBODS, Vol. 26, No. 1/2, p 189-194, November 1986. 2 tab, 7 ref.

Descriptors: *Water pollution effects, *Light intensity, *Plant growth, Wastewater, Azolla, Chlorophyll, Organic carbon, Nitrogen, Phosphorus, West Bengal, India.

Light effects on Azolla pinnata grown in effluent from three stream sites were studied during 1982-1984. The average values of the variables (chlorophyll 12.7 mg per g dry wt; organic carbon 33.8%; nitrogen 4.6%; phosphorus 0.40% on dry wt basis; and dry wt (actual growth) 55 mg per g wet wt) were higher at a light intensity of 1200 micromol per sq m per s than at that of 700 micromol per sq m per s (chlorophyll 11.3 mg per g dry wt; organic carbon 30.7%; nitrogen 3.8%; phosphorus 0.33% on dry wt basis; and dry wt 48 mg per g wet wt). The highest values (the average values of chlorophyll 14.9 mg per g dry wt; organic carbon 38.8%; nitrogen 5.4%; phosphorus 0.48% on dry wt basis; and dry wt 62 mg per g wet wt) were recorded in the months of August, September, and October in a year of high light intensity. The variables were also highest with the highly-polluted-water (from Sadhanpur) culture and lowest with the non-polluted-water (from Kanchannagar) culture; while the polluted-water (from Alamganj) culture was intermediate in the months of August, September, and October in a year with light intensity of 1200 micromol per sq m per s. (Author's abstract)
W89-00127

GROWTH STRATEGIES AND DISTRIBUTION OF ISOETIDS IN SCOTTISH FRESHWATER LOCHS,
Saint Andrews Univ. (Scotland). Dept. of Plant Biology and Ecology.
A. M. Farmer, and D. H. N. Spence.
Aquatic Botany AQBODS, Vol. 26, No. 3/4, p 247-258, December 1986. 3 fig, 47 ref.

Descriptors: *Acid rain effects, *Lakes, *Plant growth, *Scotland, *Ecological distribution, *Eutrophication, *Aquatic plants, *Macrophytes, Isoetids, Subularia, Littorella, Light intensity, Limiting nutrients, Mesotrophic lakes, Drainage, Acidic water.

The isoetids are one of the commonest ecological groupings of aquatic macrophytes in Scotland. Their growth strategies involve a range of features associated with Grime's classification of plant strategies. Subularia aquatica is a characteristic ruderal, although all of the isoetids occur in habitats that are disturbed. Littorella uniflora and Isoetes lacustris are relatively stress-tolerant with respect to low light. L. uniflora is also better able to withstand competition than the other isoetids. All are stress-tolerant when considering growth form and the nutrient limitation of the habitats in which they commonly occur. L. uniflora has a much wider range of distribution than the other isoetids

with regard to alkalinity or nutrient status of any loch. An experimental growth study confirmed that L. uniflora is faster growing and has a greater response to increasing nutrients than Lobelia dortmanna, and this is used to explain its greater tolerance of mesotrophic environments. Decline of the isoetids in Scotland is found to be due to drainage, reservoir construction, acidification and eutrophication. Eutrophication is thought to be the most important, although evidence on these factors is limited. This is discussed in relation to the growth strategies of these plants. (Author's abstract)
W89-00129

LAKE ENRICHMENT BY SUBMERSED MACROPHYTES: A NORWEGIAN WHOLE-LAKE EXPERIENCE WITH ELODEA CANADENSIS,
Norsk Inst. for Vannforskning, Oslo.
For primary bibliographic entry see Field 2H.
W89-00131

SCANNING ELECTRON MICROSCOPY OF BACTERIA AND DIATOMS ATTACHED TO A SUBMERGED MACROPHYTE IN AN INCREASINGLY POLLUTED STREAM,
Hohenheim Univ., Stuttgart (Germany, F.R.). Inst. fuer Bodenkunde und Standortslehre.
H. J. Lorch, and J. C. G. Ottow.
Aquatic Botany AQBODS, Vol. 26, No. 3/4, p 377-384, December 1986. 4 fig, 12 ref.

Descriptors: *Water pollution effects, *Stream biota, *Electron microscopy, *Epiphytes, *Bacteria, *Diatoms, *Submerged plants, *Macrophytes, Ranunculus, Phytoplankton, Leaves, Population density, Sphaerotilus, Species composition, Biological filters, Enrichment, Germany, Streams.

The natural community of epiphytic bacteria and diatoms on the submerged macrophyte Ranunculus trichophyllus was examined using scanning electron microscopy. To evaluate the effects of organic pollution on planktonic and epiphytic microflora, different sites were selected along a chalk stream (Erms) with increasing organic pollution. Planktonic bacteria, measured both by viable and direct counts, increased with enhanced water pollution. Microscopic examinations showed an increased amount of cocci in unpolluted zones whereas rods of large size were more numerous in polluted zones. Submerged leaves from unpolluted and polluted sites showed a dense epiphytic community which was irregularly spread over the surface. At both sites, density as well as form and size of the epiphytic microflora was approximately the same. Only the high density of Sphaerotilus natans on leaves of the polluted zone reflected the different saprobic levels in the Erms. Cocconeis placentula was common both in polluted and unpolluted waters. Factors affecting the structure of the epiphyte community are discussed. It is suggested that submerged macrophytes act as filters that enrich nutrients. Therefore, planktonic and epiphytic bacteria may react differently in various zones of the River Erms. (Author's abstract)
W89-00132

EFFECT OF 3,4 BENZOPYRENE ON THE PHOTOSYNTHETIC AND RESPIRATORY INTENSITY OF THE GREEN ALGA SCENEDESMUS QUADRICAUDA (DER EINFLUSS VON 3,4-BENZPYREN AUD DIE PHOTOSYNTHESE- UNE RESPIRATIONSINTENSITAT DER GRUENALGE SCENEDESMUS QUADRICAUDA),
Rostock Univ. (German D.R.). Dept. of Biology.
A. S. Abarzua, E. Wittenburg, and H. Arndt.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 67, No. 2, p 213-229, March 1984. 6 fig, 57 ref. English summary.

Descriptors: *Algal growth, *Scenedesmus, *Benzopyrene, *Water pollution effects, *Chlorophyta, *Photosynthesis, *Respiration, Carbon dioxide, Lethal limit, Enzymes, Radioactive tracers, Carbon radioisotopes, Cytochrome oxidase activity.

The effect of six different 3,4-benzopyrene concentrations (0.05-50 mg/l) on photosynthetic intensity, growth and chlorophyll-a content were tested on the green alga Scenedesmus quadricauda. The higher the 3,4-benzopyrene concentration and the longer the incubation time, the more significant is the inhibition of photosynthetic activity (O2 production), growth and chlorophyll-a content. The highest sublethal 3,4-benzopyrene concentration at experimental conditions used was 5 mg/l. Short- and long-term effects of the 3,4-benzopyrene concentration on photosynthetic and respiratory intensity as well as C-14 fixation and cytochrome oxidase activity were investigated. O2 production and CO2 assimilation are significantly inhibited after brief exposure to 3,4-benzopyrene. Prolonged exposure to 3,4-benzopyrene almost completely blocks photosynthesis (C-14 fixation). Photosynthesis may be inhibited directly, but gradually less than other known primary sites of action (DNA-, RNA-, protein-synthesis). The respiratory intensity was not affected by short-term treatment with a sublethal concentration of 3,4-benzopyrene. When exposure to 3,4-benzopyrene is prolonged, Respiration intensity decreases significantly. It is not directly inhibited and still less than inhibition of photosynthesis. Cytochrome oxidase activity decreases significantly during prolonged exposure to 3,4-benzopyrene. (Miller-PTT)
W89-00135

TOXICITY OF AN ANIONIC DETERGENT TO THE SPAWN AND LARVAE OF ANURANS (AMPHIBIA),
Humboldt-Univ. zu Berlin (German D.R.). Museum fur Naturkunde.
J. Plotner, and R. Gunther.
Internationale Revue der Gesamten Hydrobiologie IGHYAZ, Vol. 72, No. 6, p 759-771, 1987. 7 fig, 5 tab, 36 ref.

Descriptors: *Amphibians, *Detergents, *Toxicity, *Sulfonates, *Fauna, *Water pollution, Bioassay, Solvents, Polyphosphates, Larvae, Spawning.

Several experiments were performed to test the toxicity of FIT, a washing-up and general cleaning alkane sulfonate-based detergent containing about 10% sodium alkane monosulfonate (industrial name E30) to spawn and larvae of anura. The LC sub 50 values for spawn were between 0.00162% (Rana dalmatina) and 0.00497% (Rana temporaria). The sensitivity of anuran larvae depended on the concentration and duration of exposure to the detergent as well as on the development and differentiation stage of the organisms. The toxicity of FIT is not due solely to the alkanesulfonate it contains, but also results from the joint action of the surfactant, polyphosphates and solvents. The results indicate that detergents may be harmful to the amphibian fauna of Central Europe. (Author's abstract)
W89-00139

SEASONAL COMPOSITION, BIOMASS AND PRIMARY PRODUCTIVITY OF THE PHYTOPLANKTON IN LAKITELEK BACKWATER DURING 1980 AND 1983,
Lower-Tisza District Water Authority, Szeged (Hungary).
For primary bibliographic entry see Field 2H.
W89-00144

TISZA WATER, AS IRRIGATION WATER, POLLUTED WITH VARIOUS COMPOUNDS,
Jozsef Attila Univ., Szeged (Hungary). Dept. of Biophysics.
For primary bibliographic entry see Field 3C.
W89-00145

MONITORING OF MERCURY POLLUTION IN DUTCH COASTAL WATERS BY MEANS OF THE TELEOSTEAN FISH ZOARCES VIVIPARUS,
Rijkswaterstaat, The Hague (Netherlands). Div. of Tidal Waters.
K. Essink.
Netherlands Journal of Sea Research NJSRBA, Vol. 19, No. 2, p 177-182, November 1985. 5 fig, 5 tab, 27 ref.

Descriptors: *The Netherlands, *Bioindicators, *Eelpout, *Mercury, *Water pollution, *Water pollution effects, *Fish, *Coastal waters, Industrial wastewater, Heavy metals, Tissue analysis, Wadden Sea, Comparison studies, Fate of pollutants, Seasonal variation, River Rhine, Ems estuary, Scotland, Firth of Forth.

Zoarces viviparus was used as an indicator to monitor mercury pollution in Dutch coastal waters. No evidence was found for seasonal variation in muscle tissue mercury contents. In the western Dutch Wadden Sea, mercury contents have decreased due to a reduced mercury discharge by the river Rhine. A similar decrease was found in the Ems estuary following a reduction of industrial waste discharges. In 1981, mercury contents in Zoarces viviparus in all coastal waters investigated were equally low. However, comparison with mercury contents found in the Firth of Forth (Scotland) shows that contamination with mercury is still clearly present in Dutch coastal waters. (Author's abstract)
W89-00150

MODELLING RESEARCH ON THE PRODUCTION CYCLE OF PHYTOPLANKTON IN THE SOUTHERN BIGHT OF THE NORTH SEA IN RELATION TO RIVERBORNE NUTRIENT LOADS,
Nederlands Inst. voor Onderzoek der Zee, Texel.
For primary bibliographic entry see Field 2L.
W89-00157

ROLE OF SEWAGE EFFLUENT IN THE ACCUMULATION OF MACROALGAL MATS ON INTERTIDAL MUDFLATS IN TWO BASINS IN SOUTHERN ENGLAND,
Southern Water Authority, Otterbourne (England).
P. G. Soulsby, D. Lowthion, M. Houston, and H. A. C. Montgomery.
Netherlands Journal of Sea Research NJSRBA, Vol. 19, No. 3/4, p 257-263, December 1985. 2 fig, 4 tab, 26 ref.

Descriptors: *England, *Algae, *Eutrophication, *Limiting nutrients, *Water pollution effects, *Mud flats, *Tidal flats, *Basins, Algal growth, Nitrogen, Phosphorous, Portsmouth Harbor, Biomass, Wastewater, Effluents, Tissue analysis, Langstone Harbor.

Two intertidal basins in southern England, Portsmouth Harbor and Langstone Harbor, support large crops of the macroalgae Ulva and Enteromorpha each summer. Both harbors have received discharges of sewage, but the sewage has been removed from Portsmouth Harbor. Data from surveys of algal distribution, standing biomass, tissue nutrient concentration and water column nutrient concentration have been evaluated in order to determine the relationship between effluent discharge and macroalgal growth. No direct relationship between water column nutrient concentration and macroalgae biomass or area cover was found in the field. Concentrations of nitrogen and Nitrogen: Phosphorus ratio in the tissues suggest that nitrogen is stored in excess during the growing season. The evidence strongly indicates that further increase in sewage-derived nutrient will not result in higher standing crops of algae than currently observed. (Author's abstract)
W89-00159

SOME HYDROCHEMICAL, HYDROBIOLOGICAL, AND ICHTHYOLOGICAL FEATURES OF YUGOSLAV PART OF THE DANUBE LASTING FOR SEVERAL YEARS (EINIGE HYDROCHEMISCHE, HYDROBIOLOGISCHE UND ICHTHYOLOGISCHE EIGENSCHAFTEN DER JUGOSLAWISCHEN DONAUSTRECKE IN MEHRJAHRIGEM ZEITRAUM),
Institute for Biological Research, Belgrade (Yugoslavia).
G. Petrovic, D. Jankovic, and V. Pujin.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 68, No. 3/4, p 257-267, May 1987. 2 tab, 42 ref. English summary.

Descriptors: *Industrial wastes, *Water pollution source, *Heavy metals, *Eutrophication, *Fish populations, *Zooplankton, *Danube River, *Yugoslavia, Lead, Cadmium, Zinc, Nickel, Copper, Species composition, Seasonal variation, Rivers, Urbanization, Industrial development.

On the basis of the results of hydrochemical, hydrobiological and ichthyological research lasting for several years some features of the water of the Yugoslav section of the Danube were followed. The growth of urbanization and industry development have caused increases of heavy metals (lead, cadmium, zinc, nickel and copper), although the contamination of this part of the Danube is lower with regard to the other sectors. The process of eutrophication is evident especially in localities where municipal and industrial wastewaters overflow. Rotatoria dominate in the structure of zooplankton, and the number of species varies depending on the years, season and location. There have been no fundamental changes in the qualitative structure within a period lasting for several years, which implies a certain increase of eutrophication. The negative changes have been seen in the ichthyofauna, both in the qualitative and quantitative structure of fish population. In Djerdap reservoir, distinct changes have bben observed in the structure and composition of ichthyofauna, with expressed domination of bream. (Author's abstract)
W89-00165

INVESTIGATIONS OF THE ECOTOXICOLOGICAL EFFECT OF AN HERBICIDE IN AN AQUATIC MODEL ECOSYSTEM: II. FOOD CHAIN SIGNIFICANCE AND PESTICIDE BALANCE (UNTERSUCHUNGEN ZUR OKOTOXIKOLOGISCHEN WIRKUNG EINES HERBIZIDS IN EINEM AQUATISCHEN MODELLOKOSYSTEM: II. NAHRUNGSKETTENPROBLEME UND SCHADSTOFFBILANZIERUNG),
Technische Univ. Berlin (Germany, F.R.). Inst. fuer Technischen Umweltschutz.
G. Gunkel.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 69, No. 1, p 130-168, January 1984. 16 fig, 6 tab, 61 ref. English summary.

Descriptors: *Herbicides, *Pesticide toxicity, *Water pollution effects, *Bioaccumulation, *Biological magnification, *Ponds, *Food chains, *Path of pollutants, Atrazine, Triazine, Ecosystems, Phytoplankton, Zooplankton, Fish, Macrophytes, Sediments distribution, Atmosphere, Microcosms.

Investigations on the bioaccumulation of an herbicide (atrazine, s-triazine) are presented using a small pond as a model ecosystem. Herbicide residues in organisms at different trophic levels (phytoplankton, macrophytes, zooplankton, and fishes) during a vegetation period are given. High bioconcentration factors occur in phytoplankton during periods of small phytoplankton biomasses. Organisms of higher trophic levels only reach small bioconcentration factors, and no food-chain effect can be observed under consideration of benthic and pelagic consumers. The absolute distribution of atrazine in the compartments of the small pond during the vegetation period is given. Most of the herbicide is dissolved in the water. Losses to plants, animals, the sediment, the air and the outflow are discussed. At the end of the experiment atrazine was distributed between the compartments of the pond system - water, sediments, atmosphere, phytoplankton, and zooplankton in the ratio 11,400:660:5:2:1. (Author's abstract)
W89-00175

EFFECTS OF ACIDIFICATION AND PHOSPHORUS ADDITION ON PHYTOPLANKTON BIOMASS AND PRODUCTIVITY IN A CIRCUM-NEUTRAL MESOTROPHIC LAKE RECEIVING ACID PRECIPITATION,
West Virginia Univ., Morgantown.
For primary bibliographic entry see Field 2H.
W89-00179

MODEL ECOSYSTEMS AS A TOOL IN FRESHWATER AND MARINE RESEARCH,
National Swedish Environment Protection Board, Solna.
For primary bibliographic entry see Field 5B.
W89-00180

BIOCHEMICAL MODELS FOR THE HYPOLIMNETIC OXYGEN DEPLETION IN LAKES IMPACTED BY WASTEWATER DISCHARGES: 1. ALTERNATIVE MODELS,
McMaster Univ., Hamilton (Ontario). Dept. of Chemical Engineering.
W. J. Snodgrass, and P. S. Ng.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 72, No. 1, p 81-109, September 1985.

Descriptors: *Water pollution effects, *Limnology, *Lakes, *Oxygen depletion, *Water pollution sources, *Model studies, Simulation, Biological oxygen demand, Sediment oxygen demand, Organic compounds, Ammonia, Phosphorus, Organic nitrogen, Bacteria, Algae, Hamilton Harbor, Ontario, Canada, Wastewater disposal.

The role that land-based inputs of organics, land-based inputs of ammonia, in situ formation of algae and sediment oxygen demand have upon the initial rate of hypolimnetic oxygen depletion was examined. Hamilton Harbor, a water body impacted by wastewater discharges, was used for comparison of the mechanisms. The approach was to construct a biochemical model for each mechanism and to ascertain the portion of oxygen depletion explained by the mechanism. Simulation studies were used to calibrate a BOD model (for land-based inputs of organics) and an ammonia model (for land-based inputs of ammonia and organic N) while the total phosphorus model (for in situ formation of organics) has been calibrated in another study. The ammonia model explains approximately the same fraction of the oxygen depletion rate as does the total phosphorus model and sediment oxygen demand. Land-based inputs of organics explain a small portion (5-10%). A model which considers oxidation of ammonia by bacteria, uptake of ammonia by algae, and decay of in situ formed biomass, is required to determine the relative importance of these mechanisms. (See also W88-00189) (Author's abstract)
W89-00186

BIOCHEMICAL MODELS FOR THE HYPOLIMNETIC OXYGEN DEPLETION IN LAKES IMPACTED BY WASTEWATER DISCHARGES: 2. PHYTOPLANKTON BIOMASS MODEL,
McMaster Univ., Hamilton (Ontario). Dept. of Chemical Engineering.
W. J. Snodgrass, and P. S. Ng.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 72, No. 2, p 220-236, September 1985.

Descriptors: *Water pollution effects, *Limnology, *Lakes, *Oxygen depletion, *Phytoplankton, *Model studies, Ammonium, Organic compounds, Phosphorus, Nitrogen, Nitrification, Lake sediments, *Hypolimnion, Oxygen deficit, Biomass, Wastewater disposal.

An oxygen model was developed, based upon nitrification of land-based inputs of ammonia, oxidation of organics formed by autochthonous production and sediment oxygen demand (SOD). Formation of organics was calculated by a phytoplankton biomass model, which evaluates the relative influences of light, phosphorus and nitrogen. Predictions of the oxygen model show good agreement with observations for the rate and extent of the hypolimnetic oxygen deficit (HOD). 25% of the HOD is due to biomass decay while the remainder is due equally to nitrification and SOD. Model predictions were evaluated for water quality management strategies (diffuse, point source control). Predictions of the rate of improvement requires an SOD model which considers time factors (changes in fluxes of organics to the sediments, consumption of sediment organics). (See also W89-00186) (Author's abstract)
W89-00189

LIMITS OF GROWTH OF FIVE CHLORELLA SPECIES IN THE PRESENCE OF TOXIC HEAVY METALS,
Erlangen-Nuernberg Univ., Erlangen (Germany, F.R.). Inst. fuer Botanik nd Pharmazeutische.
E. Kessler.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 73, No. 1, p 123-128, April 1986. 1 tab, 25 ref.

Descriptors: *Heavy metals, *Toxicity, *Chlorella, *Water pollution effects, *Bioindicators, *Water treatment, Lead, Copper, Cadmium, Mercury, Growth.

Growth of 18 strains from 5 Chlorella species was measured in the presence of toxic heavy metals (Pb, Cu, Cd, and Hg). The sequence of toxicity was Hg>>Cu>Cd>Pb. Between the common and fast-growing Chlorella species, i.e., C. sorokiniana, C. vulgaris, C. saccharophila, C. fusca var. vacuolata, and C. kessleri, there are only comparatively small differences in heavy metal tolerance: C. fusca var. vacuolata has a Hg tolerance slightly higher than that of the other species, C. vulgaris exhibits a rather high Cd tolerance, whereas C. kessleri is distinctly more sensitive. C. saccharophila appears heterogeneous and comprises strains with highly different degrees of sensitivity towards Cd. (Author's abstract)
W89-00191

PERIPHYTON DIATOM COMMUNITIES AND TROPHIC STATES OF THREE SHALLOW LAKES IN THE PFYNWALD REGION OF CANTON VALAIS, SWITZERLAND,
Zurich Univ., Kilchberg (Swizerland). Hydrobiological-Limnological Station.
For primary bibliographic entry see Field 2H.
W89-00195

CHANGES IN PHYTOPLANKTON OVER A TEN-YEAR PERIOD IN A LAKE UNDERGOING DE-EUTROPHICATION DUE TO SURROUNDING PEAT BOGS,
Akademia Rolnicza, Lublin (Poland). Inst. of Natural Foundations of Plant Production.
For primary bibliographic entry see Field 2H.
W89-00196

CHARACTERISTICS OF DISTRIBUTION AND MIGRATION OF PHOSPHORUS IN DEPOSITS OF DIANCHI LAKE, (IN CHINESE),
Academia Sinica, Nanjing (China). Inst. of Geography.
For primary bibliographic entry see Field 5B.
W89-00200

EFFECTS OF ACIDIFICATION ON METAL BUDGETS OF LAKES AND CATCHMENTS,
Ontario Ministry of the Environment, Dorchester. Dorset Research Center.
P. J. Dillon, H. E. Evans, and P. J. Scholer.
Biogeochemistry, Vol. 5, No. 2, p 201-220, 1988. 1 fig, 7 tab, 63 ref.

Descriptors: *Acid rain, *Weathering, *Lakes, *Catchment areas, *Metals, *Acidic water, *Geochemistry, Acidification, Copper, Nickel, Zinc, Iron, Manganese, Aluminum, Sulfur dioxide, Sulfuric acid, Sinks, Hydrogen ion concentration, Ontario, Canada, Cycling nutrients.

Metal (Cu, Ni, Zn, Fe, Mn, and Al) budgets were measured for 5 lakes and their catchments near Sudbury, Ontario, an area severely affected by the emissions and deposition of strong acids (H_2SO_4/SO_2) and metals. Three of the lakes were circumneutral (pH 6.3-7.1) during the study period, while one lake had a pH of about 4.8 and a fifth had very low pH (about 4.4). The lakes' catchments were all sources of Al, Mn and Ni, but were sinks for Cu and Zn. The Fe results were inconsistent: two lakes' catchments were sources while three were sinks. The acidic lakes were conservative (i.e. net retention of zero) with respect to Cu and Ni, while the circum-neutral lakes were effective sinks for these 2 metals. All of the lakes were sinks for Zn and Al, but the acidic lakes were less effective. All lakes were also Fe sinks. While there was no pattern relative to the lakes' pHs, there was a trend towards increasing Fe retention with increasing

water replenishment time. The most acidic lake was actually a source of Mn, while the others were sinks. (Author's abstract)
W89-00207

ZOOPLANKTON COMMUNITY GRAZING IN A HYPERTROPHIC LAKE (HARTBEESPOORT DAM, SOUTH AFRICA),
National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 2H.
W89-00220

GROWTH AND CONVERSION EFFICIENCY OF THE CATFISH HETEROPNEUSTES FOSSILIS (BLOCH) EXPOSED TO SUB-LETHAL CONCENTRATIONS OF SODIUM PENTACHLOROPHENATE,
Bangalore Univ. (India). Dept. of Zoology.
G. Belliyappa, and S. R. Reddy.
Polskie Archiwum Hydrobiologii PAHYA2, Vol. 33, No. 1, p 115-120, 1986. 3 tab, 21 ref.

Descriptors: *Growth, *Sodium pentachlorophenate, *Pesticides, *Catfish, *Sublethal effects, *Fish physiology, *Water pollution effects, Organic compounds, Food habits, Metabolites, Aquatic animals, Bioaccumulation, Fish, Fish behavior.

Laboratory investigations on food intake, growth and conversion efficiency of the catfish Heteropneustes fossils reared in fresh water, 0.1 and 0.2 ppm sodium pentachlorophenate (Na-PCP) concentrations are described. The metabolic rate of the fish was derived from the daily food intake, growth and absorption. The two sub-lethal concentrations of Na-PCP had no effect on the daily food intake or feeding rates of the fish. However, the pesticide appeared to elevate the metabolic rate of the fish, resulting in utilization of more food energy for purposes of maintenance, SDA, swimming, and surfacing activities. This alters the conversion efficiency and growth of the fish. (Author's abstract)
W89-00243

ACUTE TOXICITY OF AMMONIA TO COMMON CARP (CYPRINUS CARPIO L.),
Akademia Rolniczo-Techniczna, Olsztyn-Kortow (Poland). Dept. of Basic Fishery Sciences.
H. Dabrowska, and H. Sikora.
Polskie Archiwum Hydrobiologii PAHYA2, Vol. 33, No. 1, p 121-128, 1986. 3 tab, 29 ref.

Descriptors: *Carp, *Ammonia, *Toxicity, *Water pollution effects, Organic compounds, Sublethal effects, Aquatic animals, Fish physiology, Fish, Mathematical analysis.

Ammonia is a widespread contaminant of the aquatic environment; it occurs in industrial wastewaters, municipal sewage, and agricultural wastes. In carp (Cyprinus carpio), the acute toxicity (median lethal concentration) of total ammonia and nonionic ammonia was determined in 48-h tests. Experiments were performed in aquaria (245 cu dm) under static conditions, i.e. without water flow; the toxic solutions were replaced every 24 h. Five ammonium compounds were used as toxic agents. eight experimental series were carried out; each series comprised 5-7 ammonia concentrations and a control fish group. The 48-h LC50 values and the 95% confidence interval were determined by the procedure of Lichfield and Wilcoxon. The concentrations of nonionic ammonia were calculated; the resulting values of 48-h LC50 of total ammonia remained within the range of 6.6-109 mg/cu dm, whereas the respective values for nonionic ammonia amounted to 1.15-1.96 mg/cu dm, depending on the ammonium compound used. (Author's abstract)
W89-00244

ESTIMATION OF PHYTOPLANKTON BIOMASS AND PRODUCTION, AND ORGANIC MATTER DECOMPOSITION IN THREE SMALL FIELD-PONDS,
Polish Academy of Sciences, Turew. Dept. of Agrobiology.
For primary bibliographic entry see Field 2H.
W89-00252

CONTEMPORARY CHANGES IN COASTAL BIOCENOSES OF THE GDANSK BAY (SOUTH BALTIC), A REVIEW,
Morski Inst. Rybacki, Gdynia (Poland).
For primary bibliographic entry see Field 2L.
W89-00254

CHANGES IN CHLOROPHYLL CONTENTS OF SWIETOKRZYSKIE LAKE PHYTOPLANKTON, AS RELATED TO QUALITATIVE AND QUANTITATIVE FLUCTUATIONS OF PHYTOPLANKTON DENSITY AND OF THE PHYSICOCHEMICAL CONDITIONS IN THIS LAKE IN SUMMER 1979,
Adam Mickiewicz Univ., Poznan (Poland). Dept. of Hydrobiology.
L. Burchardt, and J. Panczakowa.
Polskie Archiwum Hydrobiologii PAHYA2, Vol. 34, No. 2, p 177-191, 1987. 4 fig, 5 tab, 28 ref.

Descriptors: *Swietokrzyskie Lake, *Hypertrophic lakes, *Limnology, *Phytoplankton, *Chlorophyll a, *Dissolved oxygen, *Poland, Cycling nutrients, Biomass, Biological oxygen demand, Hydrogen ion concentration, Lakes, Phosphorus, Water chemistry, Nitrogen, Carbon dioxide, Light intensity, Wind, Optical properties.

The hypertrophic Swietokrzyskie Lake, in the northern part of the city of Gniezno (Poland) was studied during the whole vegetation season in 1979. Direct relationships were found among phytoplankton chlorophyll a content, Aphanizomenon flos-aquae (L.) Ralfs density, and various water quality parameters water pH, dissolved oxygen, BOD5, oxidizability, organic nitrogen, organic phosphorus, alkalinity, carbon dioxide (free and bicarbonate CO2), total hardness, calcium, magnesium, and ammonia nitrogen). The phytoplankton chlorophyll a content in vertical profile depended on light penetration, whereas the horizontal distribution depended on the force and direction of wind. (See also W89-00258) (Author's abstract)
W89-00257

QUALITATIVE AND QUANTITATIVE CHANGES IN PHYTOPLANKTON ON THE BACKGROUND OF PHYSICOCHEMICAL CHANGES IN THE WATER OF SWIETOKRZYSKIE LAKE IN THE YEARS 1977-1979,
Adam Mickiewicz Univ., Poznan (Poland). Dept. of Hydrobiology.
L. Burchardt, and J. Panczakowa.
Polskie Archiwum Hydrobiologii PAHYA2, Vol. 34, No. 2, p 193-214, 1987. 11 fig, 4 tab, 36 ref.

Descriptors: *Swietokrzyskie Lake, *Limnology, *Phytoplankton, *Biomass, *Hypertrophic lakes, *Eutrophication, *Anaerobic conditions, *Poland, *Dissolved oxygen, Cycling nutrients, Biological oxygen demand, Hydrogen ion concentration, Physical properties, Water chemistry, Seasonal variation, Chlorophyll a, Lakes, Nitrogen, Phosphorus, Flagellates, Cyanophyta.

In the course of 3 years of algological and physicochemical studies in a flux-less Swietokrzyskie Lake, strong eutrophication was demonstrated, evidenced in very high concentrations of mineral nitrogen (2.564-8.673 mg N-min/cu dm) and phosphorus (0.900-5.380 mg P/cu dm) in particular, and by cyclically recurrent blooms of Aphanizomenon flos-aquae in summer, and of Cryptomonas erosa, Cryptomonas merssoni, Chroomonas acuta, Euglena pisciformis, Koliella longiseta and Chlamydomonas sp. in spring. A constant surplus of biogenes, and, from year to year, an increasing abundance of Aphanizomenon flos-aquae were observed. The constant and high oxygen deficiency (with the exception of spring) evidenced the anaerobic conditions in the water body. These observations indicate that remedial action is needed in Lake Swietokrzyskie to improve the biological conditions. (See also W89-00257) (Author's abstract)
W89-00258

DIFFERENTIATION OF THE PHYSICAL AND CHEMICAL PROPERTIES OF BOTTOM SEDIMENTS IN PHYTOCENOSES OF MYRIOPHYLLETUM VERTICILLATI SOO 1927, POTAMOGETONETUM NATANTIS SOO 1927 AND HYDROCHARITETUM MORSUS-RANAE LANGENDONCK 1935 ASSOCIATIONS,
Warsaw Univ. (Poland). Dept .of Phytogeography.
For primary bibliographic entry see Field 2H.
W89-00259

IMPACT OF MANGANESE INTOXICATION ON THE BLOOD PYRUVIC ACID OF A FRESHWATER TROPICAL PERCH COLISA FASCIATUS,
Gorakhpur Univ. (India). Dept. of Zoology.
For primary bibliographic entry see Field 5A.
W89-00263

EFFECTS OF DISTURBANCE AND SEVERE SEASONAL FLUCTUATIONS IN ENVIRONMENTAL CONDITIONS ON NORTH TEMPERATE SHALLOW-WATER FISH ASSEMBLAGES,
Oslo Univ. (Norway). Inst. of Marine Biology.
For primary bibliographic entry see Field 2L.
W89-00282

PCB-RESISTANT DIATOMS IN THE HUDSON RIVER ESTUARY,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
E. M. Cosper, C. F. Wurster, and M. F. Bautista.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 26, No. 2, p 215-226, February 1988. 5 fig, 55 ref.

Descriptors: *Polychlorinated biphenyls, *Diatoms, *Hudson River, *Estuaries, *Tolerance, Toxicity, Phytoplankton, Organic compounds.

Diatom cells that are resistant, as well as sensitive, to the toxicity of polychlorinated biphenyls (PCB) are widespread throughout the highly polluted Hudson River estuary. A study of the distribution of PCB resistance among populations of the diatoms, Thalassiosira nordenskioldii and Asterionella glacialis, revealed few spatial or temporal patterns for the trait during spring and summer. The number of estuarine clones of A. glacialis tolerant of more than 25 ppb of PCB was greater than twice the number of clones isolated from nearshore waters at Sandy Hook, NJ. This suggests that selection pressure for PCB resistance is greater in the estuary than in the New York Bight apex. If specific sites of selection exist, the mixing of cells within the estuary, or the selection process may involve a generalized response to a multitude of pollutants. Several clones of both species tested were not only tolerant of PCB, but were actually enhanced in their growth in the presence of PCB. Such clones were distributed throughout the estuary during both seasons. Selection in the estuary favors no only resistant strains of diatoms, but forms that may utilize organic pollutants. (Author's abstract)
W89-00284

PHYSIOLOGICAL EFFECTS ON COHO SALMON AND STEELHEAD OF EXPOSURE TO SUSPENDED SOLIDS,
Oregon Cooperative Fishery Research Unit, Corvallis.
J. M. Redding, C. B. Schreck, and F. H. Everest.
Transactions of the American Fisheries Society TAFSAI, Vol. 116, No. 5, p 737-744, September 1987. 1 fig, 3 tab, 32 ref. Forest Service Contract PNW-1705-16.

Descriptors: *Fish physiology, *Salmon, *Suspended solids, *Water pollution effects, Clays, Topsoil, Ash, Fish, Bioaccumulation, Toxicity, Biological studies, Lethal limits.

Yearling coho salmon Oncorhynchus kisutch and steelhead Salmo gairdneri were exposed to high (2-3 g/L) or low (0.4-0.6 g/L) concentrations of three

kinds of suspended solids (topsoil, kaolin clay, and volcanic ash) for as long as 7-8 d. Such exposure did not cause mortality, but plasma cortisol concentrations were temporarily elevated in both species after exposure to 2-3 g/L of suspended topsoil, indicating that such exposure may have been stressful to the fish. Feeding rates of both species were reduced at high exposure concentrations. Exposure of yearling steelhead for 2 d to high or low concentrations of suspended topsoil, kaolin clay, or volcanic ash induced similar elevations of plasma cortisol levels, and, in groups exposed to high concentrations, blood hematocrits were increased. Osmoregulatory performance in fresh water and after transfer to 26% seawater was unaffected, and gill tissue appeared normal, after exposure to suspended solids. Exposure of yearling steelhead to high concentrations of suspended topsoil reduced the fishes' tolerance of subsequent infection by the bacterial pathogen Vibria anguillarum. These results suggest that coho salmon and steelhead can survive exposure to high concentrations of suspended solids, but may undergo sublethal physiological stress that reduces their performance capacity. (Author's abstract)
W89-00292

EFFECT OF LOW PH ON SURVIVAL OF BROOK TROUT EMBRYOS AND YOLK-SAC LARVAE IN WEST VIRGINIA STREAMS,
West Virginia Univ., Morgantown. Dept. of Biology.
D. M. Jordahl, and A. Benson.
Transactions of the American Fisheries Society TAFSAI, Vol. 116, No. 6, p 807-816, November 1987. 4 fig, 2 tab, 41 ref.

Descriptors: *Water pollution effects, *Hydrogen ion concentration, *Trout, *Acidification, *Acid streams, *Embryos, *Larvae, Streams, West Virginia, Virginia, Survival, Ecological effects, Little Laurel Run, Roaring Creek, Little Laurel Creek, Water temperature.

Survival of wild and domestic strains of brook trout Salvelinus fontinalis embryos and yolk-sac larvae was assessed in two acidic streams, Little Laurel Run (pH 5.0-5.8) and Little Laurel Creek (pH 4.7-5.4), and a reference stream, Roaring Creek (pH 6.1-7.2, in northern West Virginia from October 1983 to May 1984. Preliminary population surveys suggested that reproductive failure due to low pH had occurred in Little Laurel Run and Little Laurel Creek. Survival rates for all developmental stages, from embryo to yolk-sac larvae, were highest at Roaring Creek and lowest at Little Laurel Creek. Survival was lowest during the hatching period at Little Laurel Run and Little Laurel Creek, where the time to the onset of hatching was less and the hatching and yolk-ac periods were greater than in Roaring Creek. In Little Laurel Run, survival after hatching was lower for the wild strain caused by colder water temperatures. In the acidic streams, larvae activity and pigmentation were reduced, and incomplete hatching was observed. These effects were most pronounced at Little Laurel Creek. Reduced survival of embryos and yolk-sac larvae may explain the low population density and altered population structure (mostly older, larger fish were present) of brook trout at Little Laurel Run and the absence of a brook trout population at Little Laurel Creek. (Author's abstract)
W89-00293

UNIONID (MOLLUSCA:BIVALVIA) FAUNA OF THE SHENANGO RIVER IN MERCER COUNTY, PENNSYLVANIA,
Pennsylvania State Univ. Shenango Valley Campus, Sharon.
C. R. Bursey.
Proceedings of the Pennsylvania Academy of Science PPSAK, Vol. 61, No. 1, p 41-43, 1987. 2 fig, 2 tab, 9 ref.

Descriptors: *Pennsylvania, *Dam effects, *Shenango River, *Mollusks, *Mussels, Population dynamics, Species diversity, Water pollution effects, Ecological effects, Water level fluctuations.

A survey of unionid mollusks (mussels) was conducted at six sites in the Shenango River in Mercer County, Pennsylvania, during 1983 and 1984. A total of fifteen species are reported as currently occurring in the river. Two species, Pleurobenma cordatum and Anodontoides ferussacianus, may no longer be present in the river since they were found only as dead shells. The apparent decline in the mussel fauna of the Shenango River may be due to several factors. Domestic and industrial pollution as well as fertilizer and pesticide runoff may have occurred and may have been a cause. Both sewage and steel plants discharge into the river. Several large grain and dairy farms border the river. Commercial harvest of mussels from this river apparently was not a cause. A significant change in the river was brought about by the construction of Pymatuning Dam in 1934 and the Shenango River Dam in 1966. These flood control dams reduced mussel habitat by converting about 30% of the length of the Shenango River in Mercer County into standing water subject to annual drawdown; the littoral zone is are especially vulnerable to fluctuations in water levels. (Lantz-PTT)
W89-00312

BASELINE STUDY OF JORDAN CREEK, CITY OF ALLENTOWN, LEHIGH COUNTY, PENNSYLVANIA,
Lehigh Valley Conservancy, Inc., Emmaus, PA.
P. H. Klotz, and B. L. Haase.
Proceedings of the Pennsylvania Academy of Science PPSAK, Vol. 61, No. 1, p 50-58, 1987. 6 fig, 3 tab, 44 ref.

Descriptors: *Water pollution effects, *Jordan Creek, *Macroinvertebrates, *Pennsylvania, Organic wastes, Trout, Organic matter, Water quality, Benthic environment, Biomass, Sedimentation.

Stream conditions were documented for a 0.25 km segment of the Jordan Creek which is scheduled for rechannelization. Macroinvertebrate samplings, physical measurements and selected chemical tests were performed bimonthly from September 1984 through May 1985. The macroinvertebrate data were evaluated for seasonal population patterns, habitat preferences, functional group classifications, and organic waste tolerances. A biotic index, mean diversity, and equitability were also calculated. Pollution was indicated by: (1) the benthic flocculate; (2) the greater species richness of macroinvertebrates in the pool than in the riffle; (3) the predominance of 'collector' macroinvertebrates; (4) the paucity of Brown Trout (Salmo trutta); and (5) the relative abundance of White Sucker (Catostomus commersoni). The physical and chemical parameters generally were within the tolerance levels of the macroinvertebrates and fish. The flocculate seemed to reduce the complexity of the substrate and microhabitat diversity which could have resulted in fewer riffle species. As a fourth order stream, the Jordan Creek was characteristic in some ways of a slightly higher order stream. The fact that five species, all of which were collectors or collectors in combination with another functional group, made up 62% of all the sampled individuals appeared to indicate a reduced species and functional group diversity. Since 67% of the individuals and 55% of the species were determined as organic waste tolerant or facultative, the creek probably was impacted by organic pollution, along with nutrification and sedimentation. The low number of sampled Ephemeroptera, and the absence of gill-bearing Gastropoda and certain Pelecypoda support this suggestion. A low Salmo trutta biomass with a mean coefficient of condition below average implied that the creek had a reduced habitat quality most likely because of organic enrichment and sedimentation. (Lantz-PTT)
W89-00313

PERIPHYTON, BENTHIC INVERTEBRATES AND FISHES AS BIOLOGICAL INDICATORS OF WATER QUALITY IN THE EAST BRANCH BRANDYWINE CREEK,
Pennsylvania Dept. of Environmental Resources, Norristown.
For primary bibliographic entry see Field 5A.
W89-00314

DEVELOPMENTAL DEFECTS IN PELAGIC FISH EMBRYOS FROM THE WESTERN BALTIC,
Biologische Anstalt Helgoland (Germany, F.R.)
H. V. Westernhagen, V. Dethlefsen, P. Cameron, J. Berg, and G. Furstenberg.
Helgolaender Meeresuntersuchungen HEMEDC, Vol. 42, No. 1, p 13-36, 1988. 11 fig, 3 tab, 66 ref.

Descriptors: *Water pollution effects, *Fish development, *Biomonitoring, *Baltic Sea, Monitoring, Cod, Fish eggs, Plaice, Flounder, Water quality.

In February/March 1983 and 1984 a survey of pelagic fish eggs was conducted in the western Baltic (Kiel Bight), employing a horizontally towed plankton net. Maximum egg numbers in the upper meter of the S = 0.021 salinity layer were 200/100 cu m. The most abundant eggs were cod (up to 142 eggs/100 cu m), followed by plaice (up to 74 eggs/100 cu m) and flounder (20 eggs/100 cu m). A considerable percentage of embryos of all species displayed aberrant development. In 1983 18% of cod, 22% of flounder and 24% of plaice eggs caught contained defective embryos; in 1984 this number was larger, ranging from 28% in plaice over 32% in cod to 44% in flounder. Early developmental stages showed the highest malformation rates (up to 51% in the case of early flounder embryos). With progressive development, malformations decreased in numbers, being lowest prior to hatching. Highest rates of malformations were recorded in the Mecklenburg Bight in 1983. A second area with high incidence of malformation rates was located south and east of the island of Langeland. Several reasons, including environmental and anthropogenic factors, for the occurrence of malformed embryos in pelagic fish eggs are discussed. The potential of malformation rates in embryos of pelagic fish eggs as a tool for monitoring is considered. (Author's abstract)
W89-00315

SOFT BOTTOM FAUNA NEAR THE RIVER ELBE ESTUARY UNDER THE INFLUENCE OF SEWAGE SLUDGE. I. SEASONAL VARIATION OF SPECIES NUMBER, ABUNDANCE AND BIOMASS IN RELATION TO SEDIMENT STRUCTURE (DIE WEICHBODENFAUNA VOR DER ELBEMUENDUNG UNTER DEM EINFLUSS DER KLAERSCHLAMMVERKLAPPUNG. I. DIE SAISONALE VERAENDERUNG VON ARTEN- UND INDIVIDUENZAHL SOWIE BIOMASSE UNTER BERUECKSICHTIGUNG DER SEDIMENTSTRUCKTUR),
Zoologisches Inst. und Museum, Hamburg (Germany, F.R.).
U. Muehlenhardt-Siegel.
Helgolaender Meeresuntersuchungen HEMEDC, Vol. 42, No. 1, p 37-65, 1988. 11 fig, 4 tab, 110 ref. English summary.

Descriptors: *Elbe River, *Estuaries, *Sludge, *Water pollution effects, Seasonal variation, Polychaetes, Biomass, Species diversity, Aquatic fauna, Benthic environment, Spatial variation, Mollusks, Wastewater disposal.

Macrobenthic fauna and sediment structure were studied at six stations from June 1979 to April 1981. The investigations were carried out in the outer estuary of the River Elbe at depths of 15-38 m near a sewage sludge dumping site. The sediment near this area consisted of a high portion of silt. Usually, very few species and small numbers of individuals were found near that dumping ground. During summer 1980, a mass development of Abra alba and several polychaete species caused an increase in species number which broke down during the following winter. The mass development observed in the study area was apparently not directly caused by the sludge dumping itself, but reflects the natural variability of the community structure. The number of species recorded was significantly correlated with a grain size fraction > 31 micrometers, especially in summer. The seasonal and spatial fluctuation of the benthic community could be well documented by the abundance per species (N/S index). The Shannon-Wiener-Index (H') and evenness (j) were also useful indicators of community variability. The log-normal dis-

tribution did not show the seasonal and the spatial differences of the stations. The biomass at the stations near the dumping area was less except during the mass development of A. alba. The average individual weight (B/N) was shown to be a good indicator of population fluctuations; polychaete biomass was positively correlated to a grain size fraction < or = 6 micrometers, that of mollusks to a grain size fraction > 31 micrometers. (Author's abstract)
W89-00316

APPLICATION OF ECOLOGICAL MODELLING: IMPACT OF THERMAL EFFLUENT ON A SMALLMOUTH BASS POPULATION,
Ontario Ministry of Natural Resources, Thunder Bay. Fisheries Research Section.
B. J. Shuter, D. A. Wismer, H. A. Regier, and J. E. Matuszek.
Transactions of the American Fisheries Society TAFSAI, Vol. 114, No. 5, p 631-651, September 1985. 10 fig, 4 tab, 43 ref.

Descriptors: *Thermal pollution, *Model studies, *Smallmouth bass, *Powerplants, *Lake Huron, Bass, Fish, Ontario, Water temperature, Spawning, Growth, Population density.

A 20-year integrated field, laboratory, and simulation study of the impact of thermal effluent from a nuclear power plant on the smallmouth bass Micropterus dolomieui population in Baie du Dore, Lake Huron, is presented. A quantitative model was constructed to forecast the range of likely effects of the plant on the population. The model was based on the findings of 50 years of basic research on smallmouth bass ecology in Ontario and on 15 years of environmental and biological data collected at Baie du Dore before the power plant became operational. The model embodies detailed descriptions of both the natural variation in water temperature at Baie du Dore, and the mechanisms whereby variations in temperature generate variations in cohort strength. Five years of monitoring data, collected after the plant became operational, were used to evaluate the forecasts of the model. Observed effects on timing of spawning and individual growth were generally within the range defined by the forecasts. The thermal effluent also altered the distribution of adult fish and this, in turn, led to an increase in the effectiveness of the angling fishery. Data from the postoperational period were used to refine the assessment model. The revised model was then used to evaluate the long-term effects on the population of the changes observed. How the availability of extensive site-specific and species-specific data helped to deal with technical problems that have plagued other impact assessment projects is discussed along with the contributions of basic research and quantitative modelling to the effectiveness of the study. (Author's abstract)
W89-00317

SENSITIVITY OF YOUNG STRIPED BASS TO ORGANIC AND INORGANIC CONTAMINANTS IN FRESH AND SALINE WATERS,
Columbia National Fisheries Research Lab., MO.
D. Palawski, J. B. Hunn, and F. J. Dwyer.
Transactions of the American Fisheries Society TAFSAI, Vol. 114, No. 5, p 748-753, September 1985. 6 tab, 18 ref.

Descriptors: *Bass, *Water pollution effects, *Organic compounds, *Metals, *Inorganic compounds, Toxicity, Alkalinity, Hydrogen ion concentration, Cadmium, Copper, Zinc, Nickel, Chromium, Salinity, Insecticides.

The toxicity to young striped bass Morone saxatilis of a contaminant mixture composed of organic and inorganic chemicals was determined in fresh and saline waters when the fish were 35-80 d old. Decreases in water hardness and associated decreases in alkalinity and pH increased the toxicity of the mixture. This increase was attributed to changes in the speciation of inorganic chemicals in water of differing qualities. Under standard conditions for acute toxicity test, cadmium, copper, zinc, nickel, and chromium were more toxic to striped bass in soft than in slightly saline water. Overall, striped bass were as sensitive as most salmonid species to seven inorganic chemicals and three organic insecticides, and much more sensitive than the cyprinids, ictalurids, and centrarchids that have been tested. (Author's abstract)
W89-00320

AVOIDANCE OF A WATER-SOLUBLE FRACTION OF COAL LIQUID BY FATHEAD MINNOWS,
Battelle Pacific Northwest Labs., Richland, WA. Environmental Sciences Dept.
D. D. Dauble, R. H. Gray, J. R. Skalski, E. W. Lusty, and M. A. Simmons.
Transactions of the American Fisheries Society TAFSAI, Vol. 114, No. 5, p 754-760, September 1985. 4 fig, 1 tab, 26 ref. DOE Contract DE-AC06-76RL0 1830.

Descriptors: *Fathead minnows, *Coal liquid, *Water pollution effects, *Phenols, Fish behavior, Organic compounds, Toxicity, Lethal limits.

The behavioral response of fathead minnows Pimephales promelas to a water-soluble fraction (WSF) of coal liquid was evaluated in a nine-chambered circular tank (rosette). Groups of 36 fish each were tested to examine the effects of this complex organic mixture on a schooling species. Avoidance of all WSF concentrations with greater than 1.7 mg/L phenols (dye photometric measurements) occurred in 96 h replicated test series. Fish preference data were used to estimate a median avoidance concentration (AC50) or 1.54 mg/L total phenols. The observed avoidance threshold was sufficient to protect the species from acutely lethal effects reported for this coal liquid WSF, but exceeded concentrations known to be chronically toxic. (Author's abstract)
W89-00321

APPLICATION AND TESTING OF AN INDEX OF BIOTIC INTEGRITY IN SMALL, COOL-WATER STREAMS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Fisheries and Wildlife Sciences.
For primary bibliographic entry see Field 2H.
W89-00323

DOES PH AFFECT FISH SPECIES RICHNESS WHEN LAKE AREA IS CONSIDERED,
Fish and Wildlife Service, Kearneysville, WV. Eastern Energy and Land Use Team.
For primary bibliographic entry see Field 2H.
W89-00324

WASTE TRANSFORMER OIL AND PCB TOXICITY TO RAINBOW TROUT,
Columbia National Fisheries Research Lab., MO.
K. S. Mayer, F. L. Mayer, and A. Witt.
Transactions of the American Fisheries Society TAFSAI, Vol. 114, No. 6, p 869-886, November 1985. 2 fig, 8 tab, 90 ref.

Descriptors: *Water pollution effects, *Oil, *Polychlorinated biphenyls, *Trout, *Toxicity, Hydrocarbons, Aroclor, Fish physiology, Mortality, Fish diseases, Growth.

Young rainbow trout Salmo gairdneri (starting age, 17 d) were exposed to nominal concentrations of 0, 0.38, 0.75, 1.5, 3.0, and 6.0 micrograms/L total polychlorinated biphenyls (PCBs) for 90 d, then held in fresh water for 60 d. Sources of PCBs were: (1) waste transformer oil containing various hydrocarbons plus a 1:2 ratio of Aroclors 1254 and 1260; and (2) pure technical PCBs of the same Aroclor ratio as that in the transformer oil. Survival of fish was much lower in transformer oil than in technical PCBs at day 90. Growth was reduced at day 30 by the transformer oil but not until day 90 at the highest concentration of technical PCBs. Fin erosion was severe and vertebra integrity was reduced in fish exposed to transformer oil but not in fish exposed to technical PCBs. Abnormal swimming behavior of fish exposed to transformer oil was attributed to reduced volume of the swim bladder. Exposures to transformer oil decreased hematocrit, and increased serum cortisol to twice that of controls and of fish exposed to technical PCBs. Exposure to either PCB source increased disease resistance of fish to flush (external) challenges of the bacterium Yersinia ruckeri, but intraperitoneal injection of Y. ruckeri caused faster mortality of fish exposed to transformer oil than of control fish or fish exposed to technical PCBs. All routes of disease exposure should be considered in contaminant-disease interactions. Disease susceptibility or any clinical endpoints measured were never more sensitive indicators of contaminant stress than those endpoints normally examined (growth and survival) in chronic toxicity studies. Because fish took up more PCBs from the technical solutions than from transformer oil, presumably due to petroleum hydrocarbons in transformer oil, environmental assessments of PCBs should include testing the form of the material that may enter the environment. (Author's abstract)
W89-00328

LEACHING OF RETORTED OIL SHALE: ASSESSING THE TOXICITY TO COLORADO SQUAWFISH, FATHEAD MINNOWS, AND TWO FOOD-CHAIN ORGANISMS,
Columbia National Fisheries Research Lab., MO.
D. F. Woodward, R. G. Riley, M. G. Henry, J. S. Meyer, and T. R. Garland.
Transactions of the American Fisheries Society TAFSAI, Vol. 114, No. 6, p 887-894, November 1985. 4 tab, 27 ref. DOE Contracts DE-AC02-82ER60071 and DE-AC06-76LR-1830.

Descriptors: *Leaching, *Oil shale, *Toxicity, *Squawfish, *Fathead minnows, *Water pollution effects, Food chain, Potassium, Lithium, Magnesium, Molybdenum, Sulfates, Sodium, Nitrates, Leachates, Colorado River, Daphnia, Mayflies, Path of pollutants, Strontium, Path of pollutants.

Development of a large shale-oil industry in Colorado, Utah, and Wyoming would result in disposal of large volumes of retorted shale. Water percolating through these wastes could leach toxicants into the surface waters of the upper Colorado River system. Leachate from field lysimeters containing shale that had gone through the Paraho retorting process 6 years before had high concentrations of K, Li, Mg, Mo, Na, SO4, and NO3. Total concentrations of organics in leachate were low; nitrogen-containing aromatic hydrocarbons approximated background concentrations. In 96-h exposures, undiluted leachate was not toxic to fathead minnows Pimephales promelas or Colorado squawfish ptychocheilus lucius, and was only slightly toxic to the mayfly Hexagenia bilineata and to Daphnia magna. In 30-d exposures to different concentrations of the leachate, a concentration of 6:94 (percent leachate:percent dilution water) caused reduced growth of fathead minnows and reduced survival of mayflies. The highest test concentration not causing toxic effects was 3:97. This dilution represented conductivity of 1,080 microS/cm and total dissolved solids of 750 mg/L - values that are 1.2 to 2.0 times higher than in the Colorado and White rivers at the Colorado-Utah border. The elements Li and Sr appeared to be selectively accumulated by the two fish species. Deleterious effects of leachates from retorted oil shale appear to be unlikely in major rivers with large dilution factors. Feeder streams and backwater areas with less flushing may require protection. (Author's abstract)
W89-00329

ACUTE TOXICITY OF THIOCYANATE TO TROUT,
British Columbia Univ., Vancouver. Dept. of Zoology.
T. A. Heming, R. V. Thurston, E. L. Meyn, and R. K. Zajdel.
Transactions of the American Fisheries Society TAFSAI, Vol. 114, No. 6, p 895-905, November 1985. 3 fig, 8 tab, 46 ref. EPA Contract CR807240.

Descriptors: *Toxicity, *Thiocyanate, *Trout, *Water pollution effects, Bioaccumulation, Lethal limits, Fish physiology, Tissue analysis.

Acutely toxic effects of thiocyanate (SCN(-)) were studied in brook trout Salvelinus fontinalis and rainbow trout Salmo gairdneri exposed to concentrations of up to 518 mg/L SCN(-). These fish were capable of accumulating thiocyanate against its concentration gradient and at relatively rapid rates dependent upon the exposure SCN(-) concentration, fish size, and anionic composition of the exposure water. Uptake of thiocyanate was inhibited by external chloride, was accompanied by a decline in the plasma Cl(-) concentration, and, therefore, presumably involved substitution of SCN(-) for Cl(-) at the HCO3(-)/Cl(-) exchange sites of the gill. Endogenous conversion of thiocyanate to cyanide was detected in exposed trout; the molar equilibrium ratio of SCN(-) to HCN in blood was approximately 664:1. Determinations of 96-h median lethal concentrations were of limited value in assessing the toxicity of thiocyanate because of anomalous deaths of exposed fish. These deaths were characterized by convulsions, gasping, loss of equilibrium and buoyancy, flaring of the operculae, darkening of the skin epithelium and, within minutes, cessation of ventilation and extreme rigor. This 'sudden death syndrome' (SDS) could be triggered by strenuous exercise, abrupt changes in photoperiod, and increased levels of spontaneous activity. The SDS may involve a direct effect of SCN(-) on neuromuscular functioning. Prevalence of SDS was closely correlated with the plasma thiocyanate concentrations; SDS occurred in half the fish when plasma concentrations reached approximately 250 mg/L SCN(-). (Author's abstract)
W89-00330

ADAPTATION OF PHYTOPLANKTON-DEGRADING MICROBIAL COMMUNITIES TO THERMAL REACTOR EFFLUENT IN A NEW COOLING RESERVOIR,
Georgia Univ., Athens. Dept. of Microbiology.
S. A. Schoenberg, R. Benner, P. Sobecky, and R. E. Hodson.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 6, p 1481-1487, June 1988. 7 fig, 1 tab, 29 ref. U.S. Dept. of Energy contract DE-AC09-76SR00-819.

Descriptors: *Temperature effects, *Thermal stress, *Water temperature, *Adaptation, *Cooling ponds, *Nuclear powerplants, Phytoplankton, Carbon radioisotopes, Mineralization, South Carolina, Thermal pollution, Isotope studies, Sediments, Radioactive tracers, Biodegradation, Savannah River Plant, Steel Creek, Metabolism.

In water column and sediment inocula from a nuclear reactor cooling reservoir L-reactor at Savannah River Plant, Steel Creek, South Carolina, natural phytoplankton substrate labeled with 14C was used to determine aerobic and anaerobic mineralization rates for a range of temperatures (25, 40, 55, and 70 C) expected during reactor operation. For experiments that were begun during reactor shutdown, aerobic decomposition occurred at temperatures of < 55 C. After 2 months of reactor operation, aerobic rates increased substantially at 55 and 70 C, although maximum rates were observed at temperatures of < or = 40 C. The temperature range for which maximum anaerobic mineralization (i.e., the sum of CH4 and CO2) was observed was 25 to 40C when the reactor was off, expanding to 25 to 55 C during reactor operation. Increased rates at 55 C, but not 70 C, correlated with an increase in the ratio of cumulative methane to carbon dioxide produced over 21 days. When reduced reactor power lowered the maximum temperature of the reservoir to 42 C, aerobic decomposition at 70 C was negligible, but remained substantial at 55 C. Selection for thermophilic decomposers occurred rapidly in this system in both aerobic and anaerobic communities and did not require prolonged exposure to elevated temperatures. (Author's abstract)
W89-00336

INVESTIGATIONS OF CHLORINATED THIOPHENES: A GROUP OF BIOACCUMULABLE COMPOUNDS IDENTIFIED IN THE EFFLUENTS FROM KRAFT BLEACHING,
Senter for Industriforskning, Oslo (Norway).
For primary bibliographic entry see Field 5B.
W89-00360

ENVIRONMENTAL EFFECTS OF PAPER INDUSTRY WASTEWATERS: AN OVERVIEW,
National Council of the Paper Industry for Air and Stream Improvement, Inc., New York.
I. Gellman.
Water Science and Technology WSTED4, Vol. 20, No. 2, p 59-65, 1988.

Descriptors: *Environmental effects, *Water pollution effects, *Pulp and paper industry, *Pulp wastes, *Wastewater, Reviews, Wastes, Industrial wastes, Research priorities, Taste, Odor, Organoleptic properties, Water quality, Color, Optical properties, Drinking water.

An overview is presented of the current status of environmental concerns facing the paper industry. Four specific areas are addressed: (1) an identification of the broad range of environmental effects of paper industry wastewaters; (2) methodological approaches that have been employed in research into these problems; (3) the identification of some important research needs; and (4) the development of a simple conceptual framework for considering such research as part of the industry's problem definition and problem solution effort. Problems discussed include taste, odor, receiving water discoloration, slime growth, bacteriological water quality, and fisheries resource management. Methodological considerations include field surveys and laboratory simulation, and the study of individual functional or species effects in contrast to overall ecosystem impact. Important research needs include determination of acceptable ecosystem norms and normal variability, bioaccumulation, selection of suitable bioassay organisms and procedures, assessment of ecosystem benefits of new technologies, and the development of an integrated ecosystem approach to assessing environmental effects. (Author's abstract)
W89-00362

PHYSIOLOGICAL DISTURBANCES IN FISH EXPOSED TO BLEACHED KRAFT MILL EFFLUENTS,
National Swedish Environment Protection Board, Nykoeping. Brackish Water Toxicology Lab.
A. Larsson, T. Andersson, L. Forlin, and J. Hardig.
Water Science and Technology WSTED4, Vol. 20, No. 2, p 67-76, 1988. 4 fig, 2 tab, 22 ref.

Descriptors: *Fish physiology, *Bleaching wastes, *Toxicity, *Water pollution effects, Animal physiology, Wastes, Industrial wastes, Mills, Kraft mills, Effluents, Indicators, Liver, Enzymes, Metabolism, Blood, Fish.

Physiological methods, previously used as health indicators in laboratory investigations on fish exposed to environmental pollutants, were applied to feral fish inhabiting coastal waters polluted by bleached kraft mill effluents (BKME). The results show that BKME affect important physiological functions and thereby the state of health of the fish in the receiving body of water. Typical symptoms were reduced gonad growth, enlarged liver, strong induction of enzymes in the hepatic mixed function oxidase system, elevated content of ascorbic acid in liver tissue, altered carbohydrate metabolism, disturbed ion balance, and marked effects on the red and white blood cell pattern. Good agreement was found between the toxic effects detected in fish exposed to BKME in nature and those observed in laboratory investigations. The toxic effects were most pronounced in fish living up to 4.5 km from the discharge source, but some disturbances could be observed even in fish caught 8-10 km from the kraft pulp plant. This indicates that the area of influence where the BKME exert biological effects is much larger than was previously considered. (Author's abstract)
W89-00363

SUBLETHAL EFFECTS OF CHLORINATED PHENOLS AND RESIN ACIDS ON RAINBOW TROUT (SALMO GAIRDNERI),
Finnish Pulp and Paper Research Inst., Helsinki.
J. J. Tana.
Water Science and Technology WSTED4, Vol. 20, No. 2, p 77-85, 1988. 6 fig, 1 tab, 19 ref.

Descriptors: *Water pollution effects, *Toxicity, *Phenols, *Resins, *Fish, *Trout, *Pulp wastes, Wastes, Industrial wastes, Fish physiology, Blood, Enzymes, Liver, Accumulation.

The effects of toxic compounds in pulp and paper mill effluents on fish and fish physiology were investigated by studying the accumulation of 2,4-dichlorophenol, 2,4,6-trichlorophenol, and dehydroabietic acid in fish and the physiological responses of fish to this accumulation. Tests were performed at 5 micrograms/l and 50 micrograms/l, and hematological parameters were measured in the fish. The toxicants affected most of the parameters analyzed (blood hematocrit, leucocrit, hemoglobin, mean cellular hemoglobin count; plasma glucose, lactate; liver glycogen). Significant changes were also found in enzyme concentrations of UDP-glucuronyl transferase activity in the liver. Chlorinated phenols seem to increase the activity of this enzyme while the resin acids seem to decrease the activity. The accumulation of the toxicants tested is most significant at the beginning of the exposure period and the toxicants are concentrated in the liver. After 20 days of exposure, the concentrations in the liver decrease, and this shows the ability of fish to eliminate the substances tested or to change them to an excretable form. The accumulation of the toxicants seems to correlate with the physiological responses of the fish. (Author's abstract)
W89-00364

EFFECTS OF PULP MILL EFFLUENTS ON SKELETAL PARAMETERS IN FISH: A PROGRESS REPORT,
National Swedish Environment Protection Board, Nykoeping. Brackish Water Toxicology Lab.
B. E. Bengtsson.
Water Science and Technology WSTED4, Vol. 20, No. 2, p 87-94, 1988. 1 fig, 1 tab, 16 ref.

Descriptors: *Water pollution effects, *Pulp wastes, *Fish, *Toxicity, Wastes, Industrial wastes, Effluents, Sculpin, Perch.

Laboratory tests were conducted to verify the field observation that fourhorn sculpin (Myoxocephalus quadricornis) from the Gulf of Bothnia demonstrated elevated levels of deformed spins and/or vertebrae in areas polluted by bleached kraft mill effluents (BKME). Analysis of mechanical parameters (strength, elasticity) and chemical composition (calcium, phosphorus, collagen, proline, hydroxyproline) of single vertebrae after exposure to BKME diluted about 200-1,000 times confirmed the effects of the effluent on bone. Similar effects were recorded for feral perch (Perca fluviatilis) caught in the vicinity of a pulp mill and for bleak (Alburnus alburnus) exposed to BKME in the laboratory. Laboratory tests were also conducted with tetrachloro-1,2-benzoquinone (TCQ), a component of BKME. After about 4-1/2 months of exposure to 0.1 and 0.5 mg TCQ/l, sculpin demonstrated deformities and aberrant mechanical properties of vertebrae. It is suggested that the effects are the results of long-term metabolic dysfunction, leading also to other serious defects in the organism. (Author's abstract)
W89-00365

EFFECTS OF PULP MILL EFFLUENT ON A BALTIC COASTAL FISH COMMUNITY,
National Swedish Environment Protection Board, Oregrund. Coastal Water Section.
E. Neuman, and P. Karas.
Water Science and Technology WSTED4, Vol. 20, No. 2, p 95-106, 1988. 4 fig, 2 tab, 33 ref.

Descriptors: *Water pollution effects, *Environmental effects, *Fish, *Toxicity, *Pulp wastes, Wastes, Industrial wastes, Species composition, Density, Population density, Growth stages, Biomass, Perch, Herring, Larval growth stage, Eu-

trophication, Trophic level, Transparency, Optical properties, Coasts, Effluents.

Abundance and species composition of fish, including early stages, were studied along a gradient from a Bothnian pulp mill producing bleached kraft. Close to the outlet, the density of fish was very low and the recruitment drastically reduced. Farther away, biomass increased to a high level in a zone characterized by dense populations of cyprinids, mainly roach, and ruffe. Other common Baltic species, e.g., herring, perch, and sand-goby, occurred in subnormal densities. Compared to the cyprinids, the recruitment of these species was disturbed in much wider areas, which is considered to be a consequence of their larval biology. The populations of at least perch and sand-goby must largely be based on immigration. The effluent impact on the fish communities seems to be due to a combination of its eutrophicating, toxic, and repelling properties; the low transparency of the water may also be important. (Author's abstract)
W89-00366

EFFECTS OF A BLEACHED PULP MILL EFFLUENT ON GROWTH AND GONAD FUNCTION IN BALTIC COASTAL FISH,
National Swedish Environment Protection Board, Oregrund. Coastal Water Section.
O. Sandstrom, E. Neuman, and P. Karas.
Water Science and Technology WSTED4, Vol. 20, No. 2, p 107-118, 1988. 4 fig, 7 tab, 23 ref.

Descriptors: *Pulp wastes, *Bleaching wastes, *Toxicity, *Fish, *Water pollution effects, Wastes, Industrial wastes, Growth, Coasts, Perch, Effluents, Growth stages.

Growth and reproductive capacity in perch (Perca fluviatilis L.) and roach (Rutilus rutilus (L.) were studied during 1983, 1984, and 1985 in a coastal area of the Bothnian Sea affected by bleached pulp mill effluents. Comparative investigations were made at a mill producing unbleached pulp. In perch exposed to bleachery effluents, effects were observed on length increase rates, somatic condition factors, and on gonad development. The fraction of fishes displaying inhibited gonadal recrudescence was high close to the mill, and the size of developing gonads was comparatively small. Growth was faster in exposed fishes, in young-of-the-year as well as in older fish. Effects on length growth could be distinguished as far back as in 1975. Energy storage, expressed as the condition factor, was highest in exposed fishes. The effect pattern was more diffuse in roach, but examples of reduced gonad growth were noted. In conclusion, these studies provided evidence for changes in the energy allocation system in fish exposed to a bleached pulp mill effluent. (Author's abstract)
W89-00367

ORGANOCHLORINE COMPOUNDS IN THE ENVIRONMENT,
Jyvaeskylae Univ. (Finland). Dept. of Chemistry.
J. Paasivirta.
Water Science and Technology WSTED4, Vol. 20, No. 2, p 119-129, 1988. 2 fig, 80 ref.

Descriptors: *Pulp and paper industry, *Chlorinated hydrocarbons, *Water pollution, *Water pollution effects, *Toxicity, Hydrocarbons, Reviews, Accumulation, Bioaccumulation, Tissue analysis, Bleaching wastes.

Pollution by organochlorine compounds is reviewed. These compounds have been found to cause ecological damage, initially by causing declining populations. Dioxin toxicity has been shown to occur from structural binding of the toxin to a cytosolic receptor, and this action has been extended to many planar and coplanar aromatic organochlorines which are released into the environment from pesticide uses, dumping of chlorophenol wastes, chlorobleaching of pulp, disinfection of water, and combustion of organochlorines or chloride-containing materials. More efficient combustion has been developed to restrict organochlorine emissions. Recent analyses of wildlife samples have shown that certain planar or coplanar aromatic chlorohydrocarbons and ethers, rather than polychlorinated dibenzodioxins and polychlorinated dibenzofurans, could be the most important receptor-specific environmental toxins. Despite the fact that the pollution of the aquatic ecosystem by the forest industry in many areas is decreasing due to improved processes and treatment plants, organochlorine bleaching products still appear to have importance due to harmful discharges, especially since they still cause taste problems in seafood due to the bioaccumulation of chloroanisoles and chloroveratroles. (Author's abstract)
W89-00368

ENVIRONMENTAL FATE OF CHLOROGUAIACOLS AND CHLOROCATECHOLS,
Swedish Environmental Research Inst., Stockholm.
For primary bibliographic entry see Field 5B.
W89-00369

MUTAGENICITY IN PULP AND PAPER MILL EFFLUENTS AND IN RECIPIENT,
Finnish Pulp and Paper Research Inst., Helsinki.
A. Langi, and M. Priha.
Water Science and Technology WSTED4, Vol. 20, No. 2, p 143-152, 1988. 9 fig, 2 tab, 11 ref.

Descriptors: *Mutagenicity, *Water pollution effects, *Toxicity, *Pulp wastes, Wastes, Industrial wastes, Effluents, Mills, Kraft mills, Lagoons, Aerated lagoons, Wastewater treatment, Activated sludge process.

The mutagenic properties of pulp and paper mill effluents were studied in three mills: bleached kraft mill with aerated lagoon treatment (Mill 1), bleached kraft mill with activated sludge treatment (Mill 2), and mechanical pulp/paper mill (Mill 3). Both treated and untreated effluents, process streams, and molecular fractions were tested for mutagenicity (Ames test, Salmonella typhimurium TA100 and SCE sister chromatid exchange test, Chinese hamster ovary cells). To verify the potential environmental effects, the mutagenic activity of concentrated recipient lake water (Mill 2) was also studied. The Ames mutagenicity of the bleached kraft mill effluent (BKME) originated from the first chlorination filtrate; SCE mutagenicity also occurred in the alkali extraction stage filtrate (Mill 1). No Ames mutagenicity was detected in the paper mill effluent, but it was SCE mutagenic. Activated sludge treatment of BKME removed both Ames and SCE mutagenicity, but the aerated lagoon treated BKME was still SCE mutagenic. No mutagenic activity was detected in the recipient water concentration. (Author's abstract)
W89-00370

HOMING OF ADULT CHINOOK SALMON AFTER BRIEF EXPOSURE TO WHOLE AND DISPERSED CRUDE OIL,
E. L. Brannon, T. P. Quinn, R. P. Whitman, A. E. Nevissi, and R. E. Nakatani.
Transactions of the American Fisheries Society TAFSAI, Vol. 115, No. 6, p 823-827, November 1986. 3 fig, 3 tab, 30 ref.

Descriptors: *Salmon, *Oil pollution, *Ecological effects, *Water pollution effects, *Fish migration, *Animal behaviors, *Fish, Dispersants, Oil, Fish hatcheries, Oil spills.

Adult chinook salmon Oncorhynchus tshawytscha that had returned to the University of Washington, Seattle, hatchery were exposed for 1 h to either whole Prudhoe Bay crude oil, a chemical dispersant, or chemically dispersed oil in fresh water. The oil exposure concentrations were higher than under oil spill conditions measured in the field. Members of the treatment groups and similarly handled controls were held for 1 day after exposure and then displaced downstream. Neither frequency of homing (72% overall) nor days to return to the hatchery (mean = 3.2 d) were affected by the treatments. Retention of some treated fish at the hatchery determined that longevity was sufficient to prevent significant bias in estimates of homing. Later in the season, homing speed increased and longevity decreased, but homing frequency remained relatively constant. (Author's abstract)
W89-00375

COMPARISON OF LABORATORY AND FIELD OBSERVATIONS OF FISH EXPOSED TO THE HERBICIDES MOLINATE AND THIOBENCARB,
California State Dept. of Fish and Game, Rancho Cordova. Pesticide Investigations Unit.
B. J. Finlayson, and G. A. Faggella.
Transactions of the American Fisheries Society TAFSAI, Vol. 115, No. 6, p 882-890, November 1986. 3 fig, 3 tab, 35 ref. California State Water Resources Control Board Contract 1-161-420.

Descriptors: *Water pollution effects, *Fish, *Herbicides, *Molinate, *Thiobencarb, Toxicity, Steelhead, Salmon, Catfish, Bass, Lethal limits, Mortality, Carp, Farm wastes, Sacramento River, Agricultural runoff, Bioassay, Population exposure, California.

Acute toxicity tests with the rice herbicides molinate (Ordram) and thiobencarb (Bolero) and with thiobencarb-molinate mixtures on juvenile steelhead Salmo gairdneri, chinook salmon Oncorhynchus tshawytscha, channel catfish Ictalurus punctatus, and striped bass Morone saxatilis produced median lethal concentrations (96-h LC50 values) indicating that thiobencarb (0.76-1.8 mg/L) was 11 to 19 times more toxic than molinate (8.1-34 mg/L); thiobencarb-molinate mixtures at 1:1 LC50-value ratios had additive toxic effects on steelhead, chinook salmon, and channel catfish. Chronic toxicity tests with molinate produced 28-d no-observable-effect-level and lowest-observable-effect-level values for survival and hematology of 0.09 and 0.13 mg/L, respectively, for common carp Cyprinus carpio, and 1.7 and 2.6 mg/L, respectively, for channel catfish. Observations made on mortality and hematology of common carp, white catfish Ictalurus catus and channel catfish in agricultural drains containing the herbicides were compared to effects determined in laboratory toxicity tests. The herbicides are discharged from May through June into agricultural drains and, subsequently, the Sacramento River and Sacramento-San Joaquin Estuary, California. The field results agreed with laboratory observations for common carp; they were found dead in drains when concentrations of 0.13 mg molinate/L or greater lasted for 21 d or more. White and channel catfish were apparently unaffected. (Author's abstract)
W89-00376

INFLUENCE OF PH AND AMMONIA SALTS ON AMMONIA TOXICITY AND WATER BALANCE IN YOUNG CHANNEL CATFISH,
Southern Illinois Univ. at Carbondale. Fisheries Research Lab.
R. J. Sheehan, and W. M. Lewis.
Transactions of the American Fisheries Society TAFSAI, Vol. 115, No. 6, p 891-899, November 1986. 3 fig, 5 tab, 33 ref.

Descriptors: *Water pollution effects, *Hydrogen ion concentration, *Dehydration, *Ammonia, *Toxicity, *Catfish, Lethal limits, Ammonium chloride, Ammonium sulfate, Nitrogen, Biological studies, Fish physiology, Bioassay, Mortality, Blood, Osmosis.

Eight static 24-h median lethal tests were conducted with 16-g channel catfish Ictalurus punctatus at water temperatures of about 21 C. Tests were performed at four acidities with ammonium chloride and with ammonium sulfate. When compared on the basis of un-ionized ammonia nitrogen (NH3-N), ammonium chloride solutions were more toxic than ammonium sulfate solutions. Median lethal concentrations (24-h LC50s) at pH 8.8, 8.0, 7.2, and 6.0 were, respectively, 1.91, 1.45, 1.04, and 0.74 mg NH3-N/L for ammonium chloride, and 2.24, 1.75, 1.16, and 0.81 mg NH3-N/L for ammonium sulfate. Ionized ammonia (NH4) was not lethal at concentrations up to 1,787 mg NH4-N/L. Slopes of the probit regressions of NH3-N concentration versus mortality increased with decreases in pH

and were nearly vertical at pH 6.0. Hematocrits of channel catfish exposed to lethal ammonia solutions also increased with decreases in pH, indicating an effect on osmoregulation. Plasma osmolality and red blood cell diameters did not change when channel catfish were exposed to NH3-N LC50 solutions at low and high pH; increases in hematocrit were due to isotonic dehydration. Common physiological salts elicited similar blood and lethality responses from channel catfish at pH 6.0 when compared on an equimolar basis to ammonium salt solutions. Hemoconcentration seems to potentiate the toxicity of ammonia by increasing blood ammonia concentrations. If so, isotonic dehydration would account for the apparent increase in the toxicity of NH3 at low pH. Based on acute toxicity tests that account for osmotic effects, NH4 must be considered to be essentially nontoxic to channel catfish. (Author's abstract)
W89-00377

CORNEAL DAMAGE IN LARVAE OF STRIPED BASS MORONE SAXATILIS EXPOSED TO COPPER,
National Marine Fisheries Service, Oxford, MD. Oxford Lab.
J. E. Bodammer.
Transactions of the American Fisheries Society TAFSAI, Vol. 114, No. 4, p 577-583, July 1985. 3 fig, 1 tab, 21 ref.

Descriptors: *Copper, *Water pollution effects, *Sublethal effects, *Larvae, *Striped bass, Cornea, Tissue analysis, Fish physiology, Biological studies, Population exposure, Animal behavior, Heavy metals.

Four-week-old striped bass larvae were exposed for 24 h to 60, 80, 110, or 150 micrograms Cu(2+)/L prior to an examination of their corneas by light and electron microscopy. Epithelial cells were sloughed from the corneas in a dose-dependent manner; corneas from fish exposed at the highest concentration were so denuded that the stromas were exposed. Corneas from fish exposed to 80 and 110 micrograms/L also exhibited a second type of pathological response that was concentration-dependent and resulted in greatly enhanced cytoplasmic density, condensed nuclear chromatin and pyknosis, extensive cytoplasmic vacuolation, and mitochondrial swelling and degeneration in the epithelial cells. Copper-induced pathological changes of the visual system may affect the ability of larvae to feed and to respond normally to visual stimuli. (Author's abstract)
W89-00380

EFFECTS OF ORGANIC CONTAMINANTS ON REPRODUCTION OF THE STARRY FLOUNDER PLATICHTHYS STELLATUS IN SAN FRANCISCO BAY. I. HEPATIC CONTAMINATION AND MIXED-FUNCTION OXIDASE (MFO) ACTIVITY DURING THE REPRODUCTIVE SEASON,
Lawrence Livermore National Lab., CA. Environmental Sciences Div.
R. B. Spies, D. W. Rice, and J. Felton.
Marine Biology MBIOAJ, Vol. 98, No. 2, p 181-189, June 1988. 6 fig, 2 tab, 43 ref. DOE Contract W-7465-Eng-48 and NOAA Contract 40-ABNC-57590.

Descriptors: *Water pollution effects, *California, *Organic compounds, *Flounder, *Fish physiology, *Spawning, Fish, *San Francisco Bay, Mixed-function oxidase, Fish behavior, Liver, Polychlorinated biphenyls, Aromatic compounds, Hydrocarbons, San Pablo Bay, Seasonal variation, Hepatic aryl hydrocarbons, Metabolism, Reproduction, Enzymes, California, Tissue analysis.

Concentrations of neutral organic contaminants and activities of microsomal P-450 mixed-function oxidase (MFO) were measured in the livers of the starry flounder, collected from more- and less-contaminated sites in San Francisco Bay, during the 1984-1985 reproductive season. Starry flounder collected at the Berkeley (Bk) site, in the more urbanized central San Francisco Bay, had greater liver concentrations of polychlorinated biphenyls (PCBs) and polynuclear aromatic hydrocarbons (PAH) (fluorescence equivalents of pyrene) than those collected at a site in northern San Pablo Bay (SP), where urban development is less intense. Hepatic aryl hydrocarbon hydroxylase (AHH) activity, in males and in gonadally immature females fluctuated significantly from September 1984 through April 1985 with the Bk population exhibiting insignificantly greater activities during this period. Site differences were especially notable during the time of spawning (January-March), as AHH activities of starry flounder from SP declined and those from Bk remained elevated. These site differences appear to be due to P-450 isozymes (e.g. P-450E) whose activities are inducible by some PCBs and PAHs, as males and gonadlly immature females from the two sites were not different in their hepatic AHH activities when assayed in the presence of an inhibitor of P-450E, 7,8-benzoflavone (7,8-BF). Greatly reduced hepatic AHH activities in females coincided with the onset of vitellogenesis; however, a comparison of female starry flounder bearing yolky eggs from the two sites during several successive reproductive seasons indicated significantly greater AHH activity in those caught at Bk than those from SP. There was a linear relationship between hepatic AHH activity and its inhibition by 7,8-BF in all P. stellatus assayed and more than 98% of individuals caught in San Francisco Bay had hepatic AHH activities that were suppressed by 7,8-BF. (Author's abstract)
W89-00385

ACUTE TOXICITIES OF ELEVEN METALS TO EARLY LIFE-HISTORY STAGES OF THE YELLOW CRAB CANCER ANTHONYI,
California Univ., Santa Barbara. Marine Science Inst.
J. M. Macdonald, J. D. Shield, and R. K. Zimmer-Faust.
Marine Biology MBIOAJ, Vol. 98, No. 2, p 201-207, June 1988. 1 fig, 4 tab, 40 ref.

Descriptors: *Toxicity, *Water pollution effects, *Yellow crabs, *Drilling fluids, *Heavy metals, Iron, Barium, Aluminum, Nickel, Copper, Lead, Cadmium, Chromium, Manganese, Mercury, Mortality, Lethal limits, Survival, Crabs, Bioassay, Monitoring, Reproduction, Sublethal effects.

Findings from the first laboratory experiments to assess toxicities of metals found in drilling muds to embryos and prezoeae of a brachyuran crab, are reported. Embryos of Cancer anthonyi are brooded externally on the abdomen of female crabs; thus, embryos may be continuously exposed to pollutants contained in sediments of contaminated benthic habitats. Lethal concentrations of metals to embryos after 7 d exposures were: iron and barium (sulfate), 1000 mg/L; barium (chloride), 100 mg/L; aluminum and nickel, 10 mg/L; copper and lead, 1 mg/L; cadmium, chromium VI and manganese, < or = 0.01 mg/L; mercury, < or = 0.001 mg/L. All metals effectively retarded embryos from hatching at concentrations equal or lower to those causing mortality, except for cadmium. Particularly impressive was iron, which suppressed hatching at 1 to 10 mg/L, concentrations previously found non-deleterious to marine organisms and 100 times more dilute than concentrations causing significant embryo mortality. The effects of metals on embryos increased as a function of exposure duration. embryo mortality was delayed for at least 120 h at concentrations < or = 1.0 mg/L, with the exception of mercury. Lethal concentrations established at 96 h were meaningless for crab embryos, because acute toxic thresholds were not attained by that time. Larval survivorship to chromium VI, copper, and zinc increased following exposure of embryos to these metals at low concentrations (< or = 1.0 mg/L), suggesting induction of biochemical pathways for products which bind or metabolize metals. Identical exposures of embryos to lead failed to enhance subsequent larval survivorship, showing that inductions may be metal-specific. Exposures of brachyuran embryos at field sites and the success of their subsequent hatching in the laboratory may be a means of assessing environmental contamination otherwise difficult to monitor. (Author's abstract)
W89-00386

BIOCHEMICAL COMPOSITION OF THE BLUE CRAB CALLINECTES SAPIDUS EXPOSED TO THE WATER-SOLUBLE FRACTION OF CRUDE OIL,
Louisiana State Univ., Baton Rouge. Dept. of Zoology and Physiology.
S. Y. Wang, and W. B. Stickle.
Marine Biology BMIOAJ, Vol. 98, No. 1, p 23-30, May 1988. 5 fig, 3 tab, 48 ref.

Descriptors: *Water pollution effects, *Path of pollutants, *Blue crabs, *Oil pollution, Oil, Biochemistry, Chemical analysis, Tissue analysis, Crabs, Deoxyribonucleic acid, Ribonucleic acid, Physiological ecology, Growth, Lipids, Sublethal effects, Metabolism, Energy.

The biochemical composition of juvenile blue crabs, Callinectes sapidus, exposed to sublethal concentration of the water-soluble fraction of South Louisiana crude oil (0 to 2,504 ppb) for 21 d were examined. Although growth took place in all crabs, tissue content varied inversely with exposure concentration while percentage tissue water varied directly with exposure concentration. Total protein, lipid and RNA content of crabs exposed to crude oil were significantly less than that of control crabs by day 21. DNA content was not significantly different from that of control crabs, suggesting that the difference in tissue content was due to differences in cell volume and not cell number. There were no consistent differences in the concentration of the major biochemical components, indicating that the relative contribution of each of the components remained stable during the period of sublethal stress. Ratios of RNA:DNA and protein:DNA decreased in exposed crabs and were positively correlated with scope for growth and observed growth. The ratios may be useful as indirect indicators of physiological condition. Analysis of lipid classes indicated that structural lipids in stressed crabs were less affected than were lipids used for energy storage. The changes in biochemical composition suggest that the pattern of energy utilization was altered in crabs exposed to crude oil. Growth in size without comparable growth in tissue resulted in decreased tissue content. Available energy was used for growth, with little being stored in lipid reserves. (Author's abstract)
W89-00391

SUMMARY OF REPORTED FISH KILLS IN KANSAS DURING 1982,
Kansas Fish and Game Commission, Pratt. Fisheries Div.
K. L. Brunson.
Transactions of the Kansas Academy of Science, Vol. 88, No. 3-4, p 71-83, 1985. 6 fig, 2 tab, 6 ref.

Descriptors: *Water pollution effects, *Fishkill, *Kansas, *Water pollution sources, Industrial wastewater, Mortality, Economic aspects, Agricultural runoff, Ammonia, Ponds.

Seventy-three fishkills were reported to the Kansas Fish and Game Commission in 1982. These represented over 80,000 individual fish mortalities amounting to a monetary value of more than $50,000. The mean number of fish killed per incident for sites where mortality estimates were provided was 1191 with an associated $858 mean loss. Pond fisheries sustained more kills (36) than other water classes although many of these were from natural origins. However, 67% of stream fish kills were due to pollution and unnatural influences, significantly higher than fish kills in lentic waters. Industrial sources contributed 29% of the total estimated fish mortalities while about a fourth were due to agricultural origins. Although natural conditions exceeded any other single cause, resulting mortalities from natural causes made up only 12% of all fish killed. The large number of mortalities due to industrial chemicals (23,269) was due principally to the largest single fishkill for the year, caused by an ammonia spill in the Arkansas River, Barton County, affecting over 21,000 fish. Although the number of fishkill incidents was higher in 1982 than in recent years, the mean number of estimated mortalities per incident was less. (Author's abstract)

W89-00393

MACROINVERTEBRATE POPULATIONS IN A THERMALLY IMPACTED RESERVOIR,
Daily Analytical Lab., Peoria, IL.
P. Schultz-Benker, and B. J. mathis.
Transactions of the Illinois Academy of Science TISAAH, Vol. 78, No. 1 and 2, p 67-80, 1985. 5 fig, 1 tab, 38 ref.

Descriptors: *Macroinvertebrates, *Duck Creek Reservoir, *Illinois, *Thermal pollution, *Water pollution effects, Ecological effects, Mathematical studies, Species diversity, Water temperature, Seasonal variation, Water depth, Aquatic insects, Annelids, Copepods, Temperature effects, Reservoirs, Nematomorphs, Mollusks.

The macroinvertebrate community of Duck Creek Reservoir, a thermally impacted impoundment, was examined over a twelve month period to determine the effect of heated effluents on distribution and abundance. The Shannon-Weaver function, H, was used to express species diversity. The 34,139 organisms encountered were represented by 57 taxa including Nematomorpha, Annelida, Gastropoda, Ephemeroptera, Odonata, Hemiptera, Trichloptera, Coleoptera, and Diptera. Eighty-four percent of all individuals were tendipedid larvae with one species, Glyptotendipes lobiferus, contributing 57% of the total. Other dominant species present were G. senilis, Dicrotendipes nervosus, Cyrnellus marginalis, Pentaneura monilis, and Caenis sp. The number of individuals per square meter increased when water temperature was moderately elevated, but abundance and diversity both were significantly reduced by higher temperature at the immediate discharge area. Seasonal variation in the abundance of organisms appeared consistent with emergence patterns of the dominant species. Bathymetric distribution showed diversity and abundance greatest between two and four meters with a rapid decline between 6 and 10 meters. Below 10 meters, organisms were rarely encountered. (Author's abstract)
W89-00397

EFFECT OF PH AND TOTAL ION CONCENTRATION ON GROWTH RATE OF CHIRONOMUS NR. MATURUS LARVAE (DIPTERA: CHIRONOMIDAE) FROM AN ACID STRIP-MINE LAKE,
Southern Illinois Univ. at Carbondale. Dept. of Zoology.
N. M. Bates, and J. B. Stahl.
Transactions of the Illinois Academy of Science TISAAH, Vol. 78, No. 1 and 2, p 127-132, 1985. 5 tab, 20 ref.

Descriptors: *Water pollution effects, *Hydrogen ion concentration, *Growth rates, *Acid mine drainage, *Midges, Lakes, Acid lakes, Larvae, Population dynamics, Biological studies, Salinity, Dissolved solids, Adapation, Ecology.

Larvae of Chironomus nr. maturus Johannsen, a species abundant in an acid (pH 3) strip-mine lake, were raised in the laboratory in sixteen solutions combining pH's of 3.2, 4.0, 5.0, and 6.6 with total ion concentrations of 2670, 1350, 690, and 30 mg/L. Larval growth rate was significantly lower at pH 6.6 than at the three lower pH's, suggesting that a low pH is optimal for this species. Larval growth rate was unaffected by total ion concentration. (Author's abstract)
W89-00399

EUTROPHICATION OF LAKES AND RESERVOIRS: A FRAMEWORK FOR MAKING MANAGEMENT DECISIONS,
Geological Survey, Austin, TX. Water Resources Div.
W. Rast, and M. Holland.
Ambio AMBOCX, Vol. 17, No. 1, p 3-12, 1988. 3 fig, 4 tab, 40 ref.

Descriptors: *Eutrophication, *Lakes, *Reservoirs, *Environmental quality, *Water quality control, *Fnvironmental policy, Decision making, Management planning, Water use, Economic aspects.

The development of management strategies for the protection of environmental quality usually involves consideration both of technical and nontechnical issues. A logical, step-by-step framework for development of such strategies is provided. Its application to the control of cultural eutrophication of lakes and reservoirs illustrates its potential usefulness. From the perspective of the policymaker, the main consideration is that the eutrophication-related water quality of a lake or reservoir can be managed for given water uses. The approach presented here allows the rational assessment of relevant water-quality parameters and establishment of water-quality goals, consideration of social and other nontechnical issues, the possibilities of public involvement in the decision-making process, and a reasonable economic analysis within a management framework. (Author's abstract)
W89-00439

SENSITIVITY OF CORAL REEFS TO ENVIRONMENTAL POLLUTION,
Humboldt-Univ. zu Berlin (German D.R.). Museum fur Naturkunde.
D. H. H. Kuhlmann.
Ambio AMBOCX, Vol. 17, No. 1, p 13-21, 1988. 2 fig, 71 ref.

Descriptors: *Water pollution effects, *Corals, *Reefs, *Path of pollutants, Erosion, Dredging, Eutrophication, Municipal wastes, Population exposure, Pesticides, Herbicides, Agricultural chemicals, Industrial waste, Toxicity, Japan, Erosion, Radioactive waste.

Coral reefs are unique structures which have a higher biomass productivity and contain a greater number of species than any other marine ecosystem. Symbiosis between corals and unicellular algae living within the polyp tissue is the mechanism for growth of corals and the consequent production of calcium carbonate that leads to the formation of coral reefs. The detrimental effects on coral reefs and their inhabitants that result from human manipulation of the environment are discussed. For example, construction work in coral regions produces extensive erosion; dredging sand and dragging the ocean floor increase the suspension load and turbidity resulting in loss of light, which is essential for tropical reef-building corals; municipal sewage and agricultural fertilizers cause eutrophication; pesticides and herbicides used in agriculture are transported to the sea by rain and wind and cause mortality in reef organisms; industrial effluent and mineral oils are toxic to coral reef environments; radioactive contamination due to the testing of nuclear weapons is affecting all marine organisms; and trade in marine animals is helping to denude coastal areas and coral reefs. A case study of the coral reefs surrounding Ishigaki Island, Japan, is presented. (Author's abstract)
W89-00440

DEPRESSED MERCURY LEVELS IN BIOTA FROM ACID AND METAL STRESSED LAKES NEAR SUDBURY, ONTARIO,
B.A.R. Environmental, Toronto (Ontario).
For primary bibliographic entry see Field 5B.
W89-00442

DISRUPTION OF THE NITROGEN CYCLE IN ACIDIFIED LAKES,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
J. W. M. Rudd, C. A. Kelly, D. W. Schindler, and M. A. Turner.
Science SCIEAS, Vol. 240, No. 4858, p 1515-1517, June 10, 1988. 2 fig, 14 ref.

Descriptors: *Nitrogen cycle, *Acid lakes, *Acid rain, Hydrogen ion concentration, Ammonium, Nitrification, Ecosystems, Algae, Acidification.

Experimental acidification of two small soft-water lakes caused nitrification to cease at pH values of 5.4 to 5.7. The resulting blockage of the nitrogen cycle caused a progressive accumulation of ammonium. When the experimental acidification of one of the lakes was ended and the pH was raised to 5.4, nitrification resumed after a time lag of 1 yr. The specific effect that disruption of the nitrogen cycle will have on the long-term health of a lake ecosystem is unknown, but continuous cycling of nitrogen is crucial to the stability of ecosystems. One possible destabilizing effect of under ice accumulation of ammonium could be the rapid uptake of large quantities of ammonium by algae during early spring. Ammonium uptake results in equimolar H(+) accumulation, and this would occur at the same time as the low pH stress from spring snowmelt. (Lantz-PTT)
W89-00451

ECOLOGICAL AND SAPROBIOLOGICAL STATUS OF THE RHINE (DER OEKOLOGISCH-SAPROBIOLOGISCHE ZUSTAND DES RHEINS),
Bayer A.G., Leverkusen (Germany, F.R.). Umweltschutz/Analytik.
For primary bibliographic entry see Field 2H.
W89-00498

FREQUENT AND IMPORTANT CONSEQUENCES FROM INCREASED AMOUNTS OF LIQUID MANURE (HAEUFIGE UND WICHTIGE FOLGEN VERMEHRTEN GUELLEANFALLS),
Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W89-00500

EFFECTS OF SIX HEAVY METALS ON HATCHING EGGS AND SURVIVAL OF LARVA OF MARINE FISH, (IN CHINESE),
Academia Sinica, Qingdao (China). Inst. of Oceanology.
C. Keduo, L. Yumei, and H. Lanying.
Oceanologia et Limnologia Sinica OECOBX, Vol. 18, No. 2, p 138-144, March 1987. 7 fig, 3 tab, 8 fig. English summary.

Descriptors: *Heavy Metals, *Water pollution effects, *Toxicity, *Fish, Fish eggs, Hatching, Larvae, Survival, Chemical properties, Mercury, Copper, Zinc, Cadmium, Lead, Chromium, Brackish water, Seawater, Tolerance.

The effects of six heavy metals on the hatching of eggs and survival of larvae of the flatfish, Paralichthys olivaceus (Temminck and Schlegel) and Cynoglossus semilaevis Guenther, taken from Jiaozhou Bay, Qingdao was investigated. The metal ions tested are Hg, Cu, Zn, Cd, Pb and Cr. The toxic order of these metals was Hg>Cu>Zn>Cd>Cr>Pb for hatching of the eggs; it was Hg>Cu>Cd>Zn>Pb>Cr for survival of the larval fish. The egg membrane may play an important role in preventing the penetration of the metal ions. The toxicity of the metals varied with the nature of the water as follows: non-ion water> fresh water> brackish water> sea water. This may be due to a complex chemical process. The Median Tolerance Limits of the six heavy metals for the larval fish are 0.37 ppm for Hg, 0.08 ppm for Cu, 0.25 ppm for Cd, 0.50 ppm for Zn, 0.75 ppm for Pb and 7.50 ppm for Cr. (Author's abstract)
W89-00533

TRANSIENT LIVER PATHOLOGY IN PATIENTS CONSUMING WATER FROM A PRIVATE WELL CONTAMINATED BY PCBS FROM A SUBMERSIBLE WATER PUMP,
State Univ. of New York Upstate Medical Center, Syracuse.
A. Schecter.
Chemosphere CMSHAF, Vol. 16, No. 1, p 37-42, 1987. 4 fig, 7 ref.

Descriptors: *Water pollution effects, *Water pollution sources, *Groundwater pollution, *Toxicity, *Pumps, *Chlorinated hydrocarbons, *Polychlorinated biphenyls, Well water, Electrical equipment, Drinking water, Organic compounds.

Three persons who ingested polychlorinated biphenyl (PCB)-contaminated well water for one

week complained of central nervous system symptoms, discomfort, and a feeling of generalized illness. The initial liver enzymes in the blood were elevated, indicating liver damage. These enzyme levels returned to normal within one month, and the patients recovered from their acute medical problems. The source of the PCBs was a submersible water well pump. The pump oil contained 630,000 ppb of PCB; the well water, 6.6 ppb of PCB. (Cassar-PTT)
W89-00558

METHOD TO ASSESS PERIODIC RESPONSES OF AQUATIC MICROECOSYSTEMS TO PHOTOSYNTHETIC INHIBITION,
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
For primary bibliographic entry see Field 7B.
W89-00562

ECOLOGICAL PARAMETER OF SURFACE WATER IN NORTHEASTERN GREECE,
Demokritos Univ. of Thrace, Komotini (Greece).
For primary bibliographic entry see Field 5B.
W89-00564

ENVIRONMENTAL CONDITIONS IN ABU KIR BAY, EAST OF ALEXANDRIA: II. PLANKTON DISTRIBUTION, DOWNSTREAM FROM LAND-BASED EFFLUENTS,
Alexandria Univ. (Egypt). Dept. of Oceanography.
M. M. Dorgham, and M. M. Osman.
Chemosphere CMSHAF, Vol. 16, Nos. 2/3, p 559-564, 1987. 6 fig, 8 ref.

Descriptors: *Trace metals, *Path of pollutants, *Bays, *Plankton, *Water pollution effects, *Egypt, Abu Kir Bay, Alexandria, Wastewater disposal, Nutrients, Primary productivity, Productivity, Phytoplankton, Zooplankton, Invertebrates, Nitrates, Phosphates, Ammonia.

Analysis of plankton distribution in Abu Kir Bay showed two distinct regions: inshore and offshore. Plankton communities in the inshore region indicated three areas corresponding to three sewage outfalls. Directly in front of the Tabia Pumping Station outfall was a dead area with respect to phytoplankton and zooplankton. During November 1983 a marked depression in primary and secondary production was evident in the Bay. This was related to the imbalance between nutrients, i.e., extremely low nitrate-phosphate ratio and almost depleted silicate content. In the western sector of the bay production was low because of relatively high trace metals concentrations and high ammonia levels. (See also W88-00565) (Cassar-PTT)
W89-00578

ASSOCIATION BETWEEN SEAWATER POLLUTION AS MEASURED BY BACTERIAL INDICATORS AND MORBIDITY AMONG BATHERS AT MEDITERRANEAN BATHING BEACHES OF ISRAEL,
Hebrew Univ. of Jerusalem (Israel). School of Public Health.
B. Fattal, E. Peleg-Olevsky, T. Agursky, and H. I. Shuval.
Chemosphere CMSHAF, Vol. 16, Nos. 2/3, p 565-570, 1987. 1 fig, 2 tab, 6 ref.

Descriptors: *Wastewater outfall, *Water pollution effects, *Path of pollutants, *Bacteria, *Mediterranean Sea, *Swimming, *Israel, Coastal waters, Wastewater disposal, Seawater, Public health, Tel-Aviv, Beaches, Enteric bacteria, Coliforms, Outfalls, Human diseases.

Water samples from three beaches in Israel were analyzed for three microbial indicators of fecal sources during the May-August 1983 bathing season. Gordon and Sheraton beaches were located within 5 km of the raw sewage outfall to the sea; Rishon Lezion was not near any outfall. Log mean bacteria concentrations (CFU/100 ml) for the three locations (in the order Gordon, Sheraton, Rishon) were as follows: fecal coliforms, 117, 38, and 16; Enterococci, 41, 15, and 10; E. coli, 30, 9, and 5. Bathers were interviewed on the day of sampling and 3-4 days later to discover if any illness could be attributed to bathing. Two categories of bacterial concentrations were established, low and high. No excess of enteric or respiratory symptoms and skin infections were found for either high or low groups in a comparison of swimmers versus nonswimmers, except for the 0-4 age group. No excess of ear infections was detected in any age group. (Cassar-PTT)
W89-00579

INFLUENCE OF CHEMICALS UPON PLANKTON IN FRESHWATER SYSTEMS,
Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Oekologische Chemie.
J. P. Lay.
Chemosphere CMSHAF, Vol. 16, Nos. 2/3, p 581-588, 1987. 8 fig, 1 tab. European Communities Contract ENV-572 D.

Descriptors: *Water pollution effects, *Toxicity, *Ponds, *Plankton, Phytoplankton, Zooplankton, Chloroaniline, Herbicides, Dissolved oxygen, Larvae, Conductivity, Organic carbon, Daphnia, Copepods.

Mesocosms were created in a pond to determine the effects of p-chloroaniline on plankton communities and on limnological conditions. A slow-release formula produced a p-chloroaniline concentration which varied from 0.1 to 0.9 mg/liter during the 5-week study. Dissolved oxygen concentrations in the control increased for about 2 weeks, then slowly declined. In the treated mesocosms dissolved oxygen levels remained fairly constant. Conductivity of the water was higher in the treated mesocosms than in the control. Total carbon and organic carbon levels were higher in the dosed compartments than in the control; differences were not attributable to the presence of p-chloroaniline residues. Autotrophic plankton were slightly suppressed by the chemical. Whereas rotifers increased in the treated mesocosms, the population of daphnids, copepods and nauplius larvae decreased up to day 15, then remained constant. (Cassar-PTT)
W89-00581

EFFECTS OF HIGH LEVELS OF POLYCYCLIC AROMATIC HYDROCARBONS ON SEDIMENT PHYSICOCHEMICAL PROPERTIES AND BENTHIC ORGANISMS IN A POLLUTED STREAM,
Virginia Inst. of Marine Science, Gloucester Point. Div. of Chemistry and Toxicology.
W. J. Catallo, and R. P. Gambrell.
Chemosphere CMSHAF, Vol. 16, No. 5, p 1053-1063, 1987. 6 tab, 28 ref.

Descriptors: *Water pollution effects, *Benthic fauna, *Creosote, *Polycyclic Hydrocarbons, Organic compounds, Bayou Bonfouca, Louisiana, Aquatic habitats, Habitats, Ecosystems, Fungi, Bacteria, Oxidation-reduction potential, Marshes, Sediments, Streams, Fate of pollutants.

Concentrations of polycyclic aromatic hydrocarbons were determined in sediments of Bayou Bonfouca, Louisiana, and their effects on benthic organisms evaluated. This area had been heavily contaminated with creosote after a fire at a wood products treatment plant. High levels of polycyclic aromatics were found in sediments in large areas of the Bayou. The micro-/ and meiobenthic communities were adversely affected. As creosote levels increased, detrital accumulations increased and redox potentials became more oxidizing. These phenomena were related to a reduction of saprophytic biomass relative to the control area. The removal of fungi in polluted sites was probably the major factor in detrital accumulation. The reduction of the bacterial biomass was thought to be the primary cause of increasing redox potentials. (Cassar-PTT)
W89-00589

PREDICTIVE STRUCTURE-TOXICITY MODEL WITH DAPHNIA MAGNA,
Institut Pasteur de Lyon (France). Lab. of Applied Hygiene.
J. Devillers, P. Chambon, D. Zakaray, M. Chastrette, and R. Chambon.
Chemosphere CMSHAF, Vol. 16, No. 6, p 1149-1163, 1987. 3 fig, 28 ref.

Descriptors: *Toxicity, *Bioassay, *Structure-activity relationships, *Water pollution effects, *Toxicity, *Daphnia, Model studies, Organic compounds, Aromatic compounds, Aliphatic compounds, Phenols, Pesticides, Insecticides, Benzene, Chlorobenzene, Aniline, Nitroaniline, Toluene, Chlorophenols, Nitrophenols, Methyl phenols, Hydroquinone, Resorcinol, Pyrocatechol, Pyrogallol, Alcohols, Lindane, Malathion, Fenitrothion, Disulfoton, Endrin, Acetone, Organic acids, Acids, Esters, Amines, Chloroform, Chlorinated hydrocarbons, Nitrotoluene, Chloroaniline, Thiram, Chlordane, Morpholine, Triazoles, Molecular structure, Mathematical equations.

The structure-activity relationships between acute toxicity of 57 chemicals to Daphnia magna (24 h-IC50) and components of autocorrelation vectors of connectivity, Van der Waals volume, and electronegativity were examined. An equation an excellent model for these compounds ($r = 0.944$). This was used to predict the toxicity of another series of 44 compounds. However, in two cases results were badly predicted: small branched molecules such as carbon tetrachloride and large linear molecules such as decanol. (Cassar-PTT)
W89-00591

EFFECTS OF LINDANE AND ATROPINE SULPHATE ON THE TISSUES OF THE FISH, ANABAS TESTUDINEUS (BLOCH): A CHRONOTOXICOLOGICAL APPROACH,
Government Arts Coll., Ariyalur (India). Dept. of Zoology.
R. Bakthavathsalam, G. Ravikumar, and U. Balasubramanian.
Chemosphere CMSHAF, Vol. 16, No. 6, p 1339-1345, 1987. 20 fig, 20 ref.

Descriptors: *Water pollution effects, *Toxicity, *Pesticides, *Insecticides, *Fish, Lindane, Atropine, Antidotes, Sublethal effects, Mortality, Gills, Anabas testudineus, Tissue analysis.

Although structural differences were not noticed in the tissues of gills and intestine obtained from control Anabas testudineus at 0400 and 1600 hr, remarkable variations in the structure were observed in both lindane (sublethal and lethal concentrations) and atropine sulfate (antidote) treatment at both periods. The pathological effects observed in sublethal concentrations of lindane at 0400 hr were relatively less when compared to 1600 hr. But in lethal exposure, a reverse effect was observed, showing less effect at 1600 hr. Even though slight recovery was noticed in both the tissues after the fish were treated with atropine sulfate, the recovery observed after atropine sulfate in sublethal exposure was relatively very high when compared to atropine sulfate after lethal exposure. (Author's abstract)
W89-00594

PHOTO-INDUCED TOXICITY OF POLYCYCLIC AROMATIC HYDROCARBONS TO LARVAE OF THE FATHEAD MINNOW (PIMEPHALES PROMELAS),
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
K. T. Oris, and J. P. Giesy.
Chemosphere CMSHAF, Vol. 16, No. 7, p 1395-1404, 1987. 4 tab, 16 ref. Michigan Sea Grant College Program Grant MA-85AA-D-SG-045.

Descriptors: *Water pollution effects, *Toxicity, *Aromatic compounds, *Polycyclic aromatic hydrocarbons, *Hydrocarbons, *Fathead minnow, Larvae, Model studies, Fish, Structure-activity relationships, Tissue analysis, Sunlight, Light effects.

The toxicity of 12 polycyclic aromatic hydrocarbons to larvae of the fathead minnow in the presence of simulated sunlight was examined. A meas-

ure of relative toxicities of the toxic compounds was described in which waveband radiation intensity, molar extinction coefficients, and molar body concentrations of polycyclic aromatic hydrocarbons were considered. A structure-lethality relationship was developed, based on molecular structure and photochemical properties, that classifies compounds as being phototoxic or nonphototoxic. Six of the 12 compounds tested showed acute photo-induced toxicity. Median lethal time values ranged from 0.83 h for benzanthrone to 65.1 h for benzo(a)anthracene. Intermediate in toxicity, in decreasing order of toxicity, were pyrene, acridine, anthracene, and benzo(a)anthracene. Benzo(b)anthracene and benzo(g,h,i)perylene showed marginal levels of photo-induced toxicity. Benzo(e)pyrene, dibenz(a,h)anthracene, perylene, and phenanthrene showed no effect. (Cassar-PTT)
W89-00595

CHARACTERISTICS OF SOIL AFTER POLLUTION WITH WASTE WATERS FROM OLIVE OIL EXTRACTION PLANTS,
Granada Univ. (Spain). Dept. of Microbiology.
M. J. Paredes, E. Moreno, A. Ramos-Cormenzana, and J. Martinez.
Chemosphere CMSHAF, Vol. 16, No. 7, p 1557-1564, 1987. 5 tab, 20 ref.

Descriptors: *Water pollution effects, *Food-processing wastes, *Soil contamination, Olive oil wastes, Industrial wastes, Saline soils, Organic matter, Alpechins, Bacteria, Hydrogen ion concentration, Phenols, Acids.

Higher levels of soil salinity due to potassium and sodium replacement of soil cations were detected in an alkaline soil after pollution with wastewaters from olive oil extraction plants. The pH was practically unchanged and soil carbon/nitrogen ratio was increased. A reversible decrease in the count of sporulated bacteria was noted. The waste is acidic and contains about 10% of organic matter with a preponderance of a phenolic pigment and differing proportions of flavonoids, organic phenolic and nonphenolic acids, together with several minerals (K, Ca, Na salts). (Cassar-PTT)
W89-00602

LONG-TERM STUDY OF ECOSYSTEM CONTAMINATION WITH 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN,
Office of Science and Technology Policy, Washington, DC.
For primary bibliographic entry see Field 5B.
W89-00603

COMPARISON OF DRINKING WATER MUTAGENICITY WITH LEACHING OF POLYCYCLIC AROMATIC HYDROCARBONS FROM WATER DISTRIBUTION PIPES,
Syracuse Research Corp., NY. Life and Environmental Sciences Div.
D. K. Basu, J. Saxena, F. W. Stoss, J. Santodonato, and M. W. Neal.
Chemosphere CMSHAF, Vol. 16, Nos. 10-12, p 2592-2612, 1987. 1 fig, 5 tab, 31 ref. U.S. EPA Grant R806413.

Descriptors: *Polycyclic aromatic hydrocarbons, *Water pollution effects, *Water pollution sources, *Path of pollution, *Water distribution, *Hydrocarbons, Aromatic compounds, *Pipes, *Leaching, Organic compounds, Drinking water, Mutagens, Toxicity, United States.

The effects on water passing through common types of distribution pipes (cast iron/ductile iron, asbestos/cement, plastic) were studied with respect to changes in concentration of six polycyclic aromatic hydrocarbons and the possibility of changes in mutagenic potential. The six PAHs were fluoranthene, benzo(j)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, and benzo(ghi)perylene. Water supplies in 24 counties throught the United States were sampled. With the exception of finished water from a treatment plant in which the total concentration of the six PAHs was 138.5 ppt, the total initial concentration of the other treated waters ranged from zero to 13.4 ppt. After passage through the distribution pipes, the PAH concentrations were zero to 61.6 ppt, showing that PAH concentration can increase during passage through coated distribution pipes, asphalt and coal-tar being used as coatings. Mutagenic activity was also detected in many of the treated water samples; however, the activity levels did not correlated with either the transit of water through the distribution system or the levels of PAH in the water. It was suggested that the water treatment process itself could have contributed to the increase in mutagenicity seen in the finished water. (Cassar-PTT)
W89-00619

ASSESSMENT OF THE TOXICITY OF HEAVY METALS TO THE ANAEROBIC DIGESTION OF SEWAGE SLUDGE,
National Technical Univ., Athens (Greece). Div. of Water Resources.
For primary bibliographic entry see Field 5D.
W89-00631

INCREASED PHYTOPLANKTON PRIMARY PRODUCTION IN THE MARSDIEP AREA (WESTERN DUTCH WADDEN SEA),
Nederlands Inst. voor Onderzoek der Zee, Texel.
G. C. Cadee.
Netherlands Journal of Sea Research NJSRBA, Vol. 20, No. 2/3, p 285-290, August 1986. 3 fig, 2 tab, 30 ref.

Descriptors: *Phytoplankton, *Primary production, *Marsdiep Inlet, *Phosphates, *Eutrophication, Limiting factors, Wadden Sea, Ems Estuary, Dutch coast, Tidal inlets, Light intensity, Turbidity.

A series of phytoplankton primary production measurements was carried out in the Marsdiep tidal inlet (The Netherlands) in 1981/82 and in the second half of 1985. Annual phytoplankton primary production increased from about 150 gC/sq m in the period 1964 to 1976, to about 300 gC/sq m in 1981/1982 and 1985. This increase is considerable but comparable to that observed in the outer Ems estuary, eastern Wadden Sea, from 240 gC/sq m/yr in 1972/1973 to 400-500 gC/sq m/yr in 1976/1980. Although the increase is most probably due to eutrophication, as illustrated by the regular increase in phosphate in the Marsdiep area since 1950, it is difficult to explain why this affected primary production earlier than the late seventies. Primary production has probably not increased in the more turbid inner parts of the Wadden Sea, where light is the limiting factor and P values were already higher than in the inlet areas. (Miller-PTT)
W89-00674

ALGAL STUDIES OF THE RIVER ELY, SOUTH WALES, U.K.: I. PHYTOPLANKTON,
University Coll., Cardiff (Wales). Dept. of Plant Science.
For primary bibliographic entry see Field 2H.
W89-00678

EFFECTS OF OIL CONTAMINATION ON COLONIZATION OF MARINE PERIPHYTIC MICROFLORA,
Kyoto Univ. (Japan). Faculty of Agriculture.
C. E. Riquelme, and P. Garcia-Tello.
Journal of the Oceanographical Society of Japan NKGKB4, Vol. 42, No. 4, p 294-298, August 1986. 2 fig, 2 tab, 14 ref.

Descriptors: *Oil pollution, *Water pollution effects, *Marine plants, Bacteria, Protozoa, Primary production, Heterotrophic bacteria, Flora, Morphological characteristics, Physiological characteristics.

The effect of oil on periphytic marine microflora was studied on glass surfaces in situ. Two groups of glass slides were used, one with oil and one without oil. Bacteria, algae and protozoa were counted and periphytic heterotrophic bacteria were isolated. Significant differences in physiological and morphological characteristics of periphytic heterotrophic bacteria were found on both surfaces of glass slides. Quantitative differences between the microflora of both groups were also observed. Total number of each group such as bacteria, protozoa and primary producers were significantly affected by the presence of oil. (Author's abstract)
W89-00681

SNAIL DISTRIBUTIONS IN LAKE ERIE: THE INFLUENCE OF ANOXIA IN THE SOUTHERN CENTRAL BASIN NEARSHORE ZONE,
Heidelberg Coll., Tiffin, OH. Water Quality Lab.
For primary bibliographic entry see Field 2A.
W89-00683

IMPACT OF A MUNICIPAL WASTEWATER EFFLUENT ON WATER QUALITY, PERIPHYTON, AND INVERTEBRATES IN THE LITTLE MIAMI RIVER NEAR XENIA, OHIO,
Procter and Gamble Co., Cincinnati, OH. Environmental Safety Dept.
M. A. Lewis.
Ohio Journal of Science OJSCA9, Vol. 86, No. 1, p 2-8, March 1986. 2 fig, 5 tab, 33 ref.

Descriptors: *Periphyton, *Ohio, *Little Miami River, *Invertebrates, *Algae, *Phytoplankton, *Water pollution effects, *Municipal wastewater, *Wastewater, Effluents, Nitrogen compounds, Periphyton, Species diverisity, Wastewater outfall.

Water quality, periphyton and invertebrates were determined for the Little Miami River above and below a municipal wastewater outfall from July to September, 1984. The primary impact of the effluent on water quality was to increase nitrogen-containing compounds. Organophosphate and chlorinated insecticides were non-detectable in any water sample and levels of potentially toxic metals were low. A total of 122 attached periphyton species were identified from substrates colonized for four weeks during each month. Diatoms dominated the periphyton and were represented by 106 species. The more abundant forms were Amphora perpusilla and Navicula minima which comprised on the average 70% of the total cell volume. Thirty-one algal species of minor abundance were observed only above the discharge point, relative to eight restricted below the discharge in water containing approximately 15-35% effluent. During August and September, A. perpusilla comprised an average of 80% of all forms below the outfall relative to 30% above the outfall. In contrast, N. minima was more abundant above (39%) than below (2%). Despite these differences in composition, a diversity index was relatively high (ranging from 1.7 to 3.2). In addition, algal density above and below the outfall was similar. At least 20 species of invertebrates, primarily chironomids, were identified during the study. Sixteen invertebrates occurred above the discharge point and twelve occurred below. (Author's abstract)
W89-00685

SEASONAL CHANGES OF THE PROFUNDAL MACROBENTHIC COMMUNITY IN A POLLUTED LAKE,
Universita degli Studi 'La Sapienza', Rome (Italy).
M. Bazzanti, and M. Seminara.
Schweizerische Zeitschrift fuer Hydrologie SZHYA6, Vol. 47, No. 1, p 57-63, December 1985. 1 fig, 1 tab, 29 ref.

Descriptors: *Benthic fauna, *Benthos, *Population dynamics, *Lake Nemi, *Limnology, *Italy, *Eutrophication, *Water pollution effects, Ecology, Midges, Limnology, Recolonization, Oligochaetes, Seasonal variation, Biomass, Lakes, Italy, Oxygen deficit.

Late summer and winter structures of the profundal macrobenthos in a polluted lake (Lake Nemi, Central Italy) were compared to verify the relative differences in the faunal structure and the magnitude of the winter recovery of this community. Densities of oligochaetes and chironomids did not vary significantly from summer to winter, with the showing no recolonization of the profundal zone. Structure and diversity of the total fauna, and Oligochaete/Chironomid ratio were very similar in

the two periods. The results suggest that, in a severely polluted lake with a strong and lasting oxygen deficit in the hypolimnic zone, no recovery of profundal macrobenthos may be expected in improved environmental winter conditions. (Author's abstract)
W89-00693

EUTROPHICATION AND BENTHIC FAUNA OF THREE MOUNTAIN LAKES (EUTROPHISATION ET FAUNE BENTHIQUE DE TROIS LACS DE MONTAGNE),
Conservation de la Faune, Saint-Sulpice (Switzerland).
P. C. Lang.
Schweizerische Zeitschrift fuer Hydrologie SZHYA6, Vol. 48, No. 1 , p 64-70, October 1986. 3 tab, 8 ref. English sumary.

Descriptors: *Eutrophication, *Benthic fauna, *Aquatic animals, *Aquatic populations, *Switzerland, *Ecosystems, *Mountain lakes, *Trophic levels, *Oligotrophic lakes, Comparison studies, Reservoirs, Water depths, Biomass, Oligochaetes Chironomidae, Worms, Artificial lakes, Switzerland.

Zoobenthic communities were used to indicate the trophic state of three mountain lakes of western Switzerland. In these lakes, the macrobenthos consisted mainly of oligochaetes and chironomid larvae; Tubifex tubifex was the most abundant worm species. In Lakes Lioson and Hongrin, the abundance of zoobenthos did not change or increased slightly with depth and Stylodrilus heringianus was present. In Lake Chavonnes, zoobenthos decreased strongly with depth and it consisted mainly of Tubifex tubifex. These data, compared with those from other oligotrophic lakes, indicated that Lake Chavonnes was eutrophic whereas Lakes Lioson and Hongrin were oligotrophic. Lake Hongrin, an artificial lake made in 1968, was constituted a special case. Its water comes in part from mountain rivers and in part from Lake Geneva. Consequently, some benthic species of Lake Geneva have colonized Lake Hongrin and its water is warmer than in a typical mountain lake. (Author's abstract)
W89-00695

COMPARISON OF ROBUST BAYES AND CLASSICAL ESTIMATORS FOR REGIONAL LAKE MODELS OF FISH RESPONSE TO ACIDIFICATION,
Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
K. H. Reckhow.
Water Resources Research WRERAO, Vol. 24, No. 7, p 1061-1068, July 1988. 4 tab, 35 ref.

Descriptors: *Acid rain, *Acidic water, *Water pollution effects, *Limnology, *Lakes, *Mathematical models, *Fish, Bayes models, Statistics, History, Prediction, Adirondack regions, Hydrogen ion concentration, New York, Hydrologic data collection.

Empirical models of fish response to lake acidification were recently fit to a large historical data set (Fish Information Network) from the Adirondack region of the United States using classical and Bayesian methods. The models may be used to predict species presence/absence due to regional lake acidification, new data sets were used for cross validation of the candidate models. Based on this evaluation, the robust Bayes models, which are based on a compromise estimator between Bayes and empirical Bayes, were found to be the best predictors of species presence/absence in lakes. (Author's abstract)
W89-00713

METABOLIC PROCESSES INVOLVED IN REPAIR OF ESCHERICHIA COLI CELLS DAMAGED BY EXPOSURE TO ACID MINE WATER,
West Virginia Univ., Morgantown. Div. of Plant and Soil Sciences.
A. T. Wortman, and G. K. Bissonnette.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 8, p 1901-1906, August 1988. 4 fig, 2 tab, 44 ref.

Descriptors: *Water pollution effects, *Acid mine drainage, *Escherichia coli, *Bacterial physiology, *Metabolism, Population exposure, Sublethal effects, Inhibitors, Biosynthesis, Enzymes.

Escherichia coli was stressed by exposure to filter-sterilized acid mine water. Synthetic processes required for repair of sublethally injured survivors were studied by the addition of specific metabolic inhibitors to a resuscitation broth. Inhibitors of protein, RNA, DNA, lipid, and peptidoglycan synthesis as well as uncouplers and inhibitors of electron transport and ATPase activity were used. Acid-mine-water injury was severe, causing damage to the outer and cytoplasmic membranes. Repair of sublethally-injured cells required protein, RNA, and lipid synthesis as well as a proton motive force. (Author's abstract)
W89-00727

EFFECTS OF ACIDIFICATION ON MERCURY METHYLATION, DEMETHYLATION, AND VOLATILIZATION IN SEDIMENTS FROM AN ACID-SUSCEPTIBLE LAKE,
Wisconsin Univ.-La Crosse. River Studies Center.
For primary bibliographic entry see Field 5B.
W89-00731

MONITORING THE MORAY FIRTH ENVIRONMENT,
Marine Lab., Aberdeen (Scotland).
J. M. Davies, and J. M. Pirie.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 91, p 289-300, 1986. 7 fig, 3 tab, 4 ref.

Descriptors: *Monitoring, *Ocean dumping, *Moray Firth, *Water pollution sources, *Oil pollution, *Path of pollutants, *Water pollution effects, *Scotland, Environmental effects, Ecological effects, Fisheries, Estuaries, Rivers, Nigg Bay, Beatrice oilfield, Mineral wastes, Industrial wastes.

Environmental monitoring carried out in the Moray Firth (Moray Firth). Three areas of potential impact have been examined; the cryolite recovery sludge dumping ground in the inner Moray Firth, the Beatrice Oilfield, and the Nigg oil terminal. The monitoring objectives are described, some results are presented, and the scale of effects compared. In each case the effects are very localized and there was no evidence of any potential threat to fisheries. (See also W89-00775) (Author's abstract)
W89-00787

SEA AND FRESH WATERS,
Marine Lab., Aberdeen (Scotland).
For primary bibliographic entry see Field 2L.
W89-00797

ATTACHED ALGAE OF THE CLYDE AND GARNOCK ESTUARIES,
Heriot-Watt Univ., Edinburgh (Scotland). Dept. of Brewing and Biological Sciences.
M. Wilkinson, I. Fuller, and D. Rendall.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 90, p 143-150, 1986. 3 fig, 14 ref.

Descriptors: *Algae, *Scotland, *Clyde Estuary, *Eutrophication, *Water pollution effects, Sublethal effects, Toxicity, Coastal waters, Aquatic plants, Aquatic habitats, Estuaries, Diatoms, Municipal wastes, Industrial wastes, Garnode Estuary.

During the period of severe sewage pollution of the Clyde Estuary and severe industrial pollution of the Garnock Estuary, these two estuaries could be distinguished by unusual abundance of one particular alga in each estuary, Melosira nummuloides and Rosenvigiella polyrhiza, respectively. However, in terms of species presence data alone these estuaries did not differ from others in the British Isles. The dominant algal species of these two estuaries are compared and the changes in the flora in response to pollution abatement are described. Possible causes for the unusual abundances of M. nummuloides and R. polyrhiza are discussed. (Author's abstract)
W89-00807

STATUS OF FISH POPULATIONS IN THE CLYDE ESTUARY,
Clyde River Purification Board, East Kilbride (Scotland).
For primary bibliographic entry see Field 2L.
W89-00809

RECENT CHANGES IN NUMBERS OF WADERS ON THE CLYDE ESTUARY, AND THEIR SIGNIFICANCE FOR CONSERVATION,
Glasgow Univ. (Scotland). Dept. of Zoology.
R. W. Furness, H. Galbraith, I. P. Gibson, and N. B. Metcalfe.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 90, p 171-184, 1986. 4 fig, 2 tab, 38 ref.

Descriptors: *Scotland, *Water birds, *Clyde Estuary, *Firth of Clyde, *Water pollution effects, *Population dynamics, Food habits, Food chains, Seasonal variation, Reproduction, Regional analysis, Dissolved oxygen, Estuaries, Species composition, Organic loading, Fish, Competition, Ecology.

The Clyde Estuary (Scotland) is recovering from gross pollution. In the early 1970s high densities of a small number of species of intertidal invertebrates tolerant of organic enrichment and low oxygen levels provided rich feeding for large numbers of dunlin, redshank, lapwing, oystercatcher and curlew. Winter numbers of the first three species have declined considerably. The declines cannot be attributed to national changes in wader numbers and are not due to changes in breeding habitats or lack of reproductive success in particular regions, since each species wintering on the Clyde Estuary breeds in a different area. The most likely explanation of the decline, which is most pronounced in the species highly dependent on Corophium volutator, is either that reduced organic pollution has reduced the densities of the main prey, or that higher oxygen levels over the mudflats have allowed fish, particularly flounders, to enter the estuary and compete with the waders for the available prey. Although there is evidence of some birds having moved to other wintering areas, the fate of most birds is unknown. (Author's abstract)
W89-00810

PHYTOPLANKTON ECOLOGY OF THE FIRTH OF CLYDE SEA-LOCHS STRIVEN AND FYNE,
Dunstaffnage Marine Research Lab., Oban (Scotland).
For primary bibliographic entry see Field 2L.
W89-00813

LONG-TERM CHANGES IN SOME BENTHIC SPECIES IN THE FIRTH OF CLYDE, WITH PARTICULAR REFERENCE TO TELLINA TENUIS DA COSTA,
Dunstaffnage Marine Research Lab., Oban (Scotland).
P. R. O. Barnett, and J. Watson.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 90, p 287-302, 1986. 8 fig, 2 tab, 39 ref.

Descriptors: *Scotland, *Mollusks, *Thermal pollution, *Clyde Estuary, *Firth of Clyde, *Coastal waters, *Temperature effects, Climatology, Seasonal variation, Reproduction, Food habits, Food chains, Estuaries, Electric powerplants, Aquatic animals, Aquatic habitats, Species composition, Population dynamics.

Present knowledge of long-term changes in benthic species in the Firth of Clyde is reviewed. Recent work on the annual variations in seasonal cycles of the sand-dwelling bivalve Tellina tenuis da Costa shows correlations with natural and man-made variations in seawater temperature. Between

1973 and 1984 inclusive good settlements of young occurred on the two beaches examined in the autumns of years when higher mean seawater temperatures occurred in June and July. The implications are discussed in relation to cycles of climatic change. In general, settlements at Hunterston, a thermally enriched area, were considerably greater than at Kames Bay, a site affected only by natural temperature changes. However, T. tenuis at Kames Bay grew to much larger maximum sizes than at Hunterston, except in 1979, when Hunterston animals were larger. The possible interactions of food availability and the modifying effects of heated discharges are discussed. (Author's abstract)
W89-00817

BENTHIC FAUNA OF SANDY BAYS, WITH PARTICULAR REFERENCE TO IRVINE BAY,
Marine Lab., Aberdeen (Scotland).
A. Eleftheriou, M. R. Robertson, and D. J. Murison.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 90, p 317-327, 1986. 3 fig, 3 tab, 43 ref.

Descriptors: *Clyde Estuary, *Firth of Clyde, *Coastal waters, *Scotland, *Water pollution effects, *Species composition, *Population dynamics, Biomass, Organic carbon, Pollution load, Reproduction, Estuaries.

The coastal areas in the Firth of Clyde, of which Irvine Bay is a representative example, receive important amounts of industrial and urban wastes which are a cause of economic and environmental concern. Surveys of the benthos of Irvine Bay revealed a varied fauna dominated by large densities of opportunistic polychaetes such as Chaetozone and Spio and nematodes whose distribution correlated very strongly with the high organic carbon levels in the bay. The high densities and large biomass recorded in Irvine Bay were found to be 2-3 times higher than values from Loch Ewe, a clean area with normal carbon values. All evidence from this survey points towards a situation in which the fauna is enhanced, yet does not suffer a species reduction. (Author's abstract)
W89-00819

BENTHOS OF THE DEEPER SEDIMENTS OF THE FIRTH OF CLYDE, WITH PARTICULAR REFERENCE TO ORGANIC ENRICHMENT,
Dunstaffnage Marine Research Lab., Oban (Scotland).
T. H. Pearson, A. D. Ansell, and L. Robb.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 90, p 329-350, 1986. 9 fig, 1 tab, 24 ref, append.

Descriptors: *Eutrophication, *Scotland, *Water pollution effects, *Sludge disposal, *Clyde Estuary, *Firth of Clyde, *Species composition, Population dynamics, Biomass, Aquatic habitats, Pollution load, Waste disposal, Organic carbon, Limiting nutrients, Cycling nutrients, Estuaries, Coastal waters.

A general survey of the biomass of the benthic infauna of the Clyde Sea Area and the distribution and abundance of the dominant species throughout the area was based on data from surveys undertaken in 1972 and 1974. Recent surveys of the distribution of species along a well-defined gradient of organic enrichment on the Garroch Head sewage sludge disposal grounds in the central Firth of Clyde were used comparatively to suggest that benthic populations in the inner sea lochs, Kilbrannan Sound and in areas along the Ayrshire coast are markedly enriched. It is suggested that this enrichment may be caused by a general eutrophication on the Clyde Sea Area enhancing the effects of localized carbon inputs from urban areas. (Author's abstract)
W89-00820

RECENT CHANGES IN THE STATUS OF SOME CLYDE VERTEBRATES,
Scottish Natural History Museum, Kilbarchan.
J. A. Gibson.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 90, p 451-467, 1986. 54 ref, 2 append.

Descriptors: *Clyde Estuary, *Firth of Clyde, *Scotland, *Population dynamics, *Water pollution effects, Food habits, Estuaries, Pesticide runoff, Oil spills, Waste disposal.

Three comprehensive surveys of Clyde vertebrates have been carried out during the past twenty-five years, and this exceptional degree of investigation permits some very valid comparisons to be made. Distinct changes in status have taken place throughout all the vertebrate classes. The work of man has had the most obvious impact. This is sometimes deliberate, as in direct attempts at species protection or destruction. At other times the impact of man is indirect, with effects on food supply (e. g. overfishing, establishment of waste dumps), on habitat (true planting, draining wetlands), or on health (river purification, oil spills, pesticide runoff). Occasionally the effects are accidental. Many status changes are easily explained under the above headings, but others are not, and some show apparently opposite changes in closely-related species. Some changes in status are very real, and indeed are sometimes quite dramatic and obvious for all to see. Others are more apparent than real, presumably arising from increased observation. (Alexander-PTT)
W89-00826

DIFFERENCES IN THE SPECTRAL CHARACTERISTICS OF BIRCH CANOPIES EXPOSED TO SIMULATED ACID RAIN,
Institute of Terrestrial Ecology, Bangor (Wales). Bangor Research Station.
T. W. Ashenden, and J. H. Williams.
New Phytologist NEPHAV, Vol. 109, No. 1, p 79-84, May 1988. 4 fig, 2 tab, 26 ref. Welsh Office Contract LG139100/1.

Descriptors: *Radiometry, *Birch trees, *Water pollution effects, *Air pollution effects, *Acid rain, Simulated rainfall, Field tests, Canopy, Remote sensing, Trees.

Seedlings of silver birch in a polythene tunnel were exposed to simulated acid rain at pH values of 2.5, 3.5, 4.5 and 5.6 while growing in pots of either John Innes No. 2 potting compost or an Arfon series soil. Measurements of visible and near infrared radiance were taken from the canopies of groups of plants exposed to each of the rainfall treatments, after 34 weeks for plants grown in John Innes compose, and after 75 weeks for plants grown in both soils. Plots of reflectance against wavelength revealed that only plants exposed to the control pH 5.6 treatment retained the shape of curve that is characteristic of healthy green vegetation. Discriminant analysis showed that the radiometer data could be used to distinguish between birch canopies which had been exposed to the different rainfall treatments after both 34 and 75 weeks. The potential use of radiometry is discussed for identifying plants growing under the stress of acid rainfall in both controlled environments and in the field. It is apparent that further research using the more sensitive scanners now available will be required in order to improve the accuracy of this survey technique. (Author's abstract)
W89-00849

FISH, FLEAS AND PHYTOPLANKTON,
University of East Anglia, Norwich (England). School of Biological Sciences.
C. Townsend.
New Scientist NWSCAL, Vol. 118, No. 1617, p 67-70, June 1988.

Descriptors: *Phosphates, *Water pollution effects, *Nitrates, *Fish, *Phytoplankton, *Limnology, *Species composition, *Population dynamics, Food habits, Cycling nutrients, Reproduction, Fertilizers, Path of pollutants, Water pollution sources, Breeding, Agricultural runoff, Wastewater disposal, Aquatic plants.

A team of researchers at the University of East Anglia has been studying a polluted lake in the Norfolk Broads of Eastern England for many years. The fish formed a diverse and abundant community in which perch, bream and roach predominated. More recently, however, the broads have received vast amounts of nitrate and phosphate. The nitrate comes from agricultural fertilizers washing off the land, while the phosphate arrives in effluent from sewage works. The boom in nutrients has coincided with the loss of larger plants and a dramatic decline in the fishery. Perch have become scarce, and roach rather than bream are now the most abundant fish. An unusual population cycle has been discovered in the roach population of Alderfen. The picture that emerges is consistent, with good recruitment in odd years and poor recruitment in even years. In populations that have a more typical structure, with many fish aged up to 10 or more, such cycles have never been reported. The oldest fish in these more typical populations have a diet that is quite different from that of a fish under a year old, so the potential for competition between new recruits and breeding adults is muted. (Alexander-PTT)
W89-00851

POLLUTION BENEATH THE GOLDEN GATE,
M. MacQuitty.
New Scientist NWSCAL, Vol. 118, No. 1619, p 62-66, June 1988.

Descriptors: *San Francisco Bay, *Estuaries, *Water pollution sources, *Water pollution effects, Wetlands, Sediments, Public policy.

Scientists still have much to learn about how human activities affect San Francisco Bay. While some changes, such as the destruction of wetlands, may be obvious, their effects on the estuarine ecosystems are not. Other changes, such as increased contamination of the water, sediments and biota, remain poorly understood. Only in a few cases is it possible to establish a causal relationship between a particular contaminant and a harmful effect. The future of the bay and its delta depends in part on whether scientists can provide more evidence to establish the consequences of such changes. A better understanding of the estuary's problems will help policymakers to manage the environment more effectively. Inclusion of the San Francisco estuary in the EPA's National Estuary Program should accomplish this goal. (Alexander-PTT)
W89-00852

SEA-SURFACE MICROLAYER OF PUGET SOUND: PART I: TOXIC EFFECTS ON FISH EGGS AND LARVAE,
Battelle Pacific Northwest Labs., Sequim, WA. Marine Research Lab.
J. Hardy, S. Kiesser, L. Antrim, A. Stubin, and R. Kocan.
Marine Environmental Research, Vol. 23, No. 4, p 227-249, 1987. 8 fig, 2 tab, 36 ref. Contract No. DE-AC06-76RLO 1830.

Descriptors: *Air-water interfaces, *Urban areas, *Fish, *Puget Sound, *Water pollution effects, *Toxicity, *Fish physiology, Coastal waters, Bioindicators, Bays, Estuaries, Larval growth stage, Fish eggs, Hatching, Sea surface, Sublethal effects, Aquatic habitats, Reproduction.

Studies were conducted to determine the extent to which the sea surface of Puget Sound was toxic to the early life history stages of fish. Three urban bays with suspected contamination, a rural reference bay, and a Central Sound site were compared. Surface-dwelling eggs and organisms (zooneuston) were collected with a surface-skimming neuston net and their densities enumerated. Sand sole (Psettichthys melanosticus) embryos were exposed in the field and laboratory to the sea-surface microlayer, to develop a useful year round approach to monitoring sea-surface toxicity, larval development of anchovies, kelp bass, and sea urchins was also evaluated as an indication of sea-surface microlayer toxicity. During the spawning season (February and March), urban bays in Puget Sound had lower concentrations of sand sole eggs and neustonic organisms on the sea surface than did the rural bay or Central Sound reference sites. Compared to the reference sites, laboratory exposure to

surface microlayer samples collected from urban bay sites generally resulted in more chromosomal aberrations in developing sole embryos, reduced hatching success of sole larvae, and reduced growth in trout cell cultures. In situ hatching success of sole eggs was reduced by half or more in urban bays compared to reference sites. (See also W89-00854) (Author's abstract)
W89-00853

SEA-SURFACE MICROLAYER OF PUGET SOUND: PART II: CONCENTRATIONS OF CONTAMINANTS AND RELATION TO TOXICITY,
Battelle Pacific Northwest Labs., Sequim, WA. Marine Research Lab.
J. T. Hardy, E. A. Crecelius, L. D. Antrim, V. L. Broadhurst, and C. W. Apts.
Marine Environmental Research, Vol. 23, No. 4, p 251-271, 1987. 3 fig, 3 tab, 42 ref. Contract No. DE-AC06-76RLO 1830.

Descriptors: *Water pollution sources, *Fish, *Puget Sound, *Urban areas, *Air-water interfaces, *Water pollution effects, *Toxicity, Sublethal effects, Aquatic habitats, Reproduction, Fish physiology, Coastal waters, Bays, Estuaries, Sea surface, Precipitation, Runoff, Wastewater disposal, Metals, Pesticides, Hydrocarbons, Polychlorinated biphenyls.

Many aquatic contaminants, because of low water solubility or association with floatable particles, concentrate at the sea surface. Thirty-six samples of the sea-surface microlayer (SMIC), the upper 50 micron were collected from sites in Puget Sound, Washington. Sites included three urban bays, central Puget Sound, and a rural reference site. Exposure of floating fish eggs to approximately half of these samples resulted in sublethal and lethal toxic effects. Chemical analyses revealed high concentrations of contaminants in many of the samples. Major temporal and spatial differences in sea-surface chemistry occurred, but maximum (for all) and mean (for 1985) concentrations were aromatic hydrocarbons, 8030 (mean 132) microgram/L; saturate hydrocarbons, 2060 micrograms/L; pesticides, 43.8 (mean 0.46) ng/L; PCBs, 3890 (mean 631) ng/L; and total metals, 4750 (mean 626) micrograms/L. Stepwise multivariate regression indicated that the percentage of fish eggs developing to normal live larvae decreased with increasing concentrations of a complex mixture of contaminants. Principal component analysis demonstrated that the major types of contaminants did not differ greatly in their statistical contribution to the toxicity, i.e. no single chemical was responsible for the observed toxicity. The chemical composition of the SMIC samples suggested that contamination originated from a variety of sources including atmospheric deposition, terrestrial runoff of fossil fuel combustion products, and sewage disposal. (See also W89-00853) (Author's abstract)
W89-00854

TOXICITY OF SEA-SURFACE MICROLAYER: EFFECTS ON HERRING AND TURBOT EMBRYOS,
Biologische Anstalt Helgoland (Germany, F.R.)
H. von Westernhagen, M. Landolt, R. Kocan, G. Furstenberg, and D. Janssen.
Marine Environmental Research, Vol. 23, No. 4, p 273-290, 1987. 6 tab, 54 ref. US EPA Grant 811348 and NIEHS Grant ES02190.

Descriptors: *Air-water interfaces, *Embryonic growth stage, *Herring, *Turbot, *Heavy metals, *Hydrocarbons, *Sea surface, *Water pollution effects, *Toxicity, *Sublethal effects, Aquatic habitats, Reproduction, Fish physiology, Coastal waters, Bays, Estuaries, Germany, Fish.

Marine fish eggs, from herring (Clupea harengus) and turbot (Psetta maxima), were used to test the effects of the sea-surface microlayer on embryonic development. The eggs were exposed in static systems to full strength microlayer and 1, 10, 50% dilutions. Depending on the sampling site and time, microlayer contained varying amounts of Zn, Cd, Cu, Ni, Fe, Pb and Co, in concentrations 100 times above those found in subsurface bulk water. Chlorinated hydrocarbon pesticides were not found at concentrations elevated above bulk water, but considerable amounts of petroleum hydrocarbons and phthalate esters were detected. Microlayer displayed differential concentration-dependent toxicity for each species used in the experiments. Effects on hatching time as well as total hatch (%) and number of abnormal larvae were recorded. Herring eggs were most affected by Helgoland microlayer (suspected effect of high metal content) while turbot eggs were most sensitive to Travemunde and Elbe microlayer (suspected effect of high petroleum hydrocarbons). The usefulness of microlayer studies as a tool for environmental assessment is discussed. An impact of microlayer effects on recruitment in sensitive species is deemed possible. (Author's abstract)
W89-00855

TOXICITY OF SEA-SURFACE MICROLAYER: EFFECTS OF HEXANE EXTRACT ON BALTIC HERRING (CLUPEA HARENGUS) AND ATLANTIC COD (GADUS MORHUA) EMBRYOS,
Washington Univ., Seattle. School of Fisheries.
R. M. Kocan, H. von Westernhagen, M. L. Landolt, and G. Furstenberg.
Marine Environmental Research, Vol. 23, No. 4, p 291-305, 1987. 5 fig, 1 tab, 27 ref. US EPA Grant 811348 and NIEHS Grant ES02190.

Descriptors: *Air-water interfaces, *Embryonic growth stages, *Baltic Sea, *Hydrocarbons, *Sea surface *Water pollution effects, *Toxicity, *Sublethal effects, *Aquatic habitats, *Fish physiology, Coastal waters, Bioindicators, Bays, Estuaries, Herring, Cod, Fish, Hatching, Chlorinated hydrocarbons, North Sea.

A study was conducted to determine whether contaminated sea-surface microlayer was toxic to marine fish embryos in its native form and as a hexane extract. Developing embryos of Atlantic cod (Gadus morhua) and Baltic herring (Clupea harengus) were exposed to hexane extracts of sea-surface microlayer collected from five locations in the North Sea and Baltic Sea. Extracts from two of these locations produced significant embryo mortality as well as severe deformities in live hatched larvae. A control sample of bulk water collected from 20 cm under the surface and extracted in the same way produced no significant mortality or deformities. Significant changes in timing of hatching were also observed in those samples which produced embryo toxic effects. A comparison of these data with those obtained from cod embryos exposed to unextracted microlayer showed a similar biological effect with both unextracted samples and hexane extracts. Chemical analyses revealed the greatest biological effect in samples with petroleum hydrocarbon concentrations between 180 and > 200 micrograms/L. The bulk water control had 1 microgram/L while the three samples that showed no biological activity had 3 to 8 micrograms/L petroleum hydrocarbons. Phthalic acid esters were detected in four samples and chlorinated hydrocarbons in one, but could not be positively correlated with any of the toxic responses. No other chemical contaminants were detected in the five samples. (Author's abstract)
W89-00856

CONTAMINANT CONCENTRATIONS AND TOXICITY OF SEA-SURFACE MICROLAYER NEAR LOS ANGELES, CALIFORNIA,
Southern California Coastal Water Research Project, Long Beach.
J. N. Cross, J. T. Hardy, J. E. Hose, G. P. Hershelman, and L. D. Antrim.
Marine Environmental Research, Vol. 23, No. 4, p 307-323, 1987. 1 fig, 6 tab, 42 ref. SCE Research and Development Contract C3006906.

Descriptors: *Bioassay, *Air-water interfaces, *Los Angeles, *Fish, *Trace metals, *Chlorinated hydrocarbons, *Sea surface, *Water pollution effects, Toxicity, Sublethal effects, Aquatic habitats, Fish physiology, Coastal waters, Bioindicators, Bays, Estuaries, Aromatic compounds.

Sea-surface microlayer samples were collected from six nearshore areas receiving different amounts of anthropogenic inputs. The samples were analyzed for selected trace metals, chlorinated hydrocarbons, and polycyclic aromatic hydrocarbons. The relative toxicities of the samples were determined with fish embryo bioassays. Contaminant concentrations generally increased from the offshore to the inshore stations. Contaminant concentrations were several orders of magnitude higher in microlayer samples from the highly industrialized Los Angeles and Long Beach harbors compared to samples from a site 15 km offshore. Microlayer samples from the inshore stations were significantly more toxic, and induced significantly more developmental abnormalities and chromosome aberrations, than samples from the offshore stations. (Author's abstract)
W89-00857

LABORATORY STUDY OF THE ACCUMULATION AND TOXICITY OF CONTAMINANTS AT THE SEA SURFACE FROM SEDIMENTS PROPOSED FOR DREDGING,
Battelle Pacific Northwest Labs., Sequim, WA. Marine Research Lab.
For primary bibliographic entry see Field 5E.
W89-00858

HEPATIC LESIONS IN ENGLISH SOLE (PAROPHRYS VETULUS) FROM COMMENCEMENT BAY, WASHINGTON (USA),
PTI Environmental Services, Seattle, WA.
D. S. Becker, T. C. Ginn, M. L. Landolt, and D. B. Powell.
Marine Environmental Research, Vol. 23, No. 3, p 153-173, 1987. 5 fig, 5 tab, 38 ref. EPA Cooperative Agreement CX810926-01-0.

Descriptors: *Sole, *Commencement Bay, *Water pollution effects, *Toxicity, *Fish physiology, Sublethal effects, Bioindicators, Aquatic habitats, Reproduction, Spatial distribution, Coastal waters.

Prevalences of idiopathic hepatic lesions in English sole (Parophrys vetulus) were evaluated at 15 transects in Commencement Bay, Washington (a chemically contaminated embayment), and at two transects in Carr Inlet, Washington (a relatively uncontaminated reference embayment). The lesions considered were neoplasms (tumors), foci of cellular alteration (putative preneoplasms), megalocytic hepatosis and nuclear pleomorphism. Prevalences of one or more of the four lesions at 10 (67%) of the Commencement Bay transects were significantly higher than the prevalence observed in Carr Inlet. Prevalences of neoplasms and foci of cellular alteration were correlated positively with fish age, but none of the four lesions exhibited a relationship with fish sex. A significant concordance was found among the spatial distributions of the four lesions, suggesting that all were induced by similar stimuli. Length-at-age did not differ significantly between fish with and without hepatic lesions. The spatial patterns of lesion prevalences observed were similar to those found at similar locations in a previous study 3-5 years earlier, suggesting that these patterns are persistent. (Author's abstract)
W89-00859

INDUCED RESISTANCE TO POLYCHLORINATED BIPHENYLS CONFERS CROSS-RESISTANCE AND ALTERED ENVIRONMENTAL FITNESS IN A MARINE DIATOM,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
E. M. Cosper, B. J. Snyder, L. M. Arnold, L. A. Zaikowski, and C. F. Wurster.
Marine Environmental Research, Vol. 23, No. 3, p 207-222, 1987. 6 fig, 3 tab, 45 ref.

Descriptors: *Adaptation, *Pesticides, *Diatoms, *Polychlorinated biphenyls, *Water pollution effects, *Toxicity, Population exposure, Sublethal effects, Aquatic habitats, Aquatic animals, Microorganisms, Microbiological studies, Temperature effects, Salt tolerance, Limiting nutrients, Nitrogen, DDT, Estuaries.

Since a variety of toxic chemicals is typically found in chronically polluted estuaries, the ability of a marine phytoplankter to develop resistance to polychlorinated biphenyls (PCB), as well as cross-resistance to DDT, was evaluated, as were concomitant alterations of the tolerance to environmental stresses other than pollution, including temperature, salinity and nutrient availability. A clone of the marine diatom, Ditylum brightwellii, sensitive to PCB, was pretreated with sublethal concentrations of PCB over a period of thirty days by two methods: (1) a single dose of 10 micrograms/L and (2) progressively increasing doses from 10 to 30 micrograms/L. Both methods produced resistance to PCB, as well as cross-resistance to DDT. Resistance was still present two years later despite no further exposure to PCB. The PCB-resistant strain exhibited greater tolerance to PCB than the PCB-sensitive strain under all environmental conditions where its growth was possible, even at salinities, temperatures and nitrogen levels quite different from those under which resistance was induced. PCB resistance, however, decreased the tolerance of the strain to lower salinities and nitrogen limitation but increased its tolerance to lower temperatures. (Author's abstract)
W89-00860

NONPARAMETRIC APPROACHES TO ENVIRONMENTAL IMPACT ASSESSMENT,
Waterloo Univ. (Ontario). Dept. of Systems Design Engineering.
For primary bibliographic entry see Field 7C.
W89-00861

TROPICAL EUTROPHIC LAKE MODELING AND PARAMETER DISCRIMINATION,
Princeton Univ., NJ. Dept. of Aerospace and Mechanical Sciences.
For primary bibliographic entry see Field 2H.
W89-00872

SOME BIOLOGICAL ASPECTS OF LIZA ABU (HECKEL) MUGILIDAE, IN AL-DAOODI DRAIN, (BAGHDAD, IRAQ),
Scientific Research Council, Baghdad (Iraq).
For primary bibliographic entry see Field 2H.
W89-00890

ASSESSING THE BIRKENES MODEL OF STREAM ACIDIFICATION USING A MULTI-SIGNAL CALIBRATION METHODOLOGY,
Senter for Industriforskning, Oslo (Norway).
For primary bibliographic entry see Field 7B.
W89-00974

ESTIMATION OF THE RISK ASSOCIATED WITH THE ORGANIC CONSTITUENTS OF HAZARDOUS AND MUNICIPAL WASTE LANDFILL LEACHATES,
Texas A and M Univ., College Station. Dept. of Soil and Crop Sciences.
For primary bibliographic entry see Field 5B.
W89-00995

DESIGN CRITERIA FOR IN-SITU AND ON-SITE RENOVATION OF AN INDUSTRIAL SLUDGE LAGOON,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Chemical and Biochemical Engineering.
For primary bibliographic entry see Field 5B.
W89-00996

INTERACTION OF EARTHEN LINER MATERIALS WITH INDUSTRIAL WASTE LEACHATE,
Texas Univ. at Austin. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5E.
W89-00997

TERRESTRIAL BIOACCUMULATION POTENTIAL OF PHENOLIC COMPOUNDS,
Texas Univ. at Austin. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-00998

POPULATION GENETICS OF MYTILUS EDULIS (L.) FROM OSLOFJORDEN, NORWAY IN OIL-POLLUTED AND NON OIL-POLLUTED WATER,
Oslo Univ. (Norway). Inst. of Marine Biology.
S. E. Fevolden, and S. P. Garner.
Sarsia, Vol. 71, No. 3-4, p 247-257, 1986. 2 fig, 8 tab, 37 ref.

Descriptors: *Water pollution effects, *Estuaries, *Fjords, *Shellfish, *Adaptation, *Oil pollution, Mussels, Mytilus edulis, Aquatic animals, Oslo Fjord, Norway, Aquatic animals, Marine environment.

Specimens of Mytilus were analyzed electrophoretically for studies of enzyme polymorphism. On the basis of data obtained for 30 loci the average heterozygosity was estimated at 11.5 + or -3.5%. Lack of significant deviations from Hardy-Weinberg expectations of heterozygotes gave no evidence that Oslofjorden is inhabited by genetically separated stocks of M. edulis. The genetic variation at polymorphic loci like PGI and LAP appeared quite similar to what was reported earlier among mussel populations in the northern Kattegat. This could indicate genetic homogeneity over longer distances. Six polymorphic loci were compared among groups if individuals living in experimental basins, two dosed with a continuous supply of oil and two controls, and individuals from the fjord adjacent to the basins. Divergence between adults in basin and fjord populations were at other loci than between juveniles in the two environments. The juveniles also revealed different selective pressures from life in the basins in two consecutive years. It was concluded that for the loci assayed, no genotypic fitness advantage has developed in M. edulis to withstand low concentrations of oil. (Author's abstract)
W89-01009

RESULTS OF ECOLOGICAL MONITORING OF THREE BEACHES POLLUTED BY THE 'AMOCO CADIZ' OIL SPILL: DEVELOPMENT OF MEIOFAUNA FROM 1978 TO 1984,
Universite de Bretagne-Occidentale, Brest (France). Lab. d'Oceanographie Biologie.
P. Bodin.
Marine Ecology Progress Series MESEDT, Vol. 42, No. 2, p 105-123, February 18, 1988. 11 fig, 4 tab, 41 ref. NOAA/CNEXO/UBO Contracts 78/5850, 79/6184; CNEXO/UBO Contracts 82/2604, 83/7198; IFREMER/UBO Contract 84/7577.

Descriptors: *Monitoring, *Oil pollution, *Oil spills, *Beaches, *Water pollution effects, *Ecological effects, *Aquatic animals, *Bioindicators, Amoco Cadiz, France, Environmental effects, Intertidal areas, Nematodes, Copepods, Crustaceans, Density, Population density, Species diversity, Toxicity, Organic matter, Indicators, Coasts.

Following the 'Amoco Cadiz' oil spill, time-series sampling of the meiofauna was carried out from 1978 to 1984 in the intertidal zone of 3 sandy beaches on the northern Finistere coast (Brittany, France). Quantitative analysis documented 2 principal phases in the development of the main taxa (Nematoda and Copepoda). First came a degradation phase leading to impoverishment in density and diversity of the populations. This first phase could be subdivided into several stages corresponding mainly to the toxicity period and, on one beach (Kersaint), to a summer 'bloom.' Then came a recovery phase corresponding to a quantitative and qualitative reconstitution of the meiofauna. Each phase lasted a greater or lesser time according to station exposure and the considered taxon. A qualitative analysis of harpacticoid copepoda illustrated the development of population diversity and 'ecological groups.' During the first phase, replacement of the original population by a substitute fauna was observed. Correspondence factorial analysis on the development of harpacticoid communities allowed a better understanding of the main pollution and recovery factors such as toxicity, organic matter, hydrodynamism, and zoological groups. Meiofauna, particularly harpacticoid copepods, are significant bioindicators of ecological disturbances. (Author's abstract)
W89-01031

RESPONSE OF BENTHIC MEIOFAUNA TO NUTRIENT ENRICHMENT OF EXPERIMENTAL MARINE ECOSYSTEMS,
Stockholm Univ. (Sweden). Dept. of Zoology.
B. Widbom, and R. Elmgren.
Marine Ecology Progress Series MESEDT, Vol. 42, No. 3, p 257-268, February 24, 1988. 6 fig, 3 tab, 58 ref. US EPA Grants No. CR-810265 and CR-907795.

Descriptors: *Benthic fauna, *Eutrophication, *Marine environment, Environment, Fauna, Benthos, Aquatic animals, Ammonium, Phosphates, Silicates, Nutrients, Biomass, Productivity, Phytoplankton, Plankton, Aquatic plants, Species composition, Density, Population density, Nematodes, Polychaetes, Annelids, Ostracods, Crustaceans, Copepods, Mollusks, Growth stages, Juvenile growth stage, Ecology.

The long-term (2.4 yr) response of benthic meiofauna to eutrophication of experimental marine ecosystems was studied in mesocosm tanks designed to simulate Narragansett Bay (RI), on which they are situated. Ammonium, phosphate, and silicate were added daily to the mesocosms in a logarithmic progression. Phytoplankton production and biomass in the tanks increased with increasing nutrient enrichment. The benthic community gave a quantitatively less marked response to the gradient of nutrient input. The meiofauna showed remarkably little response in terms of total abundance, but significant effects were found on major taxa, leading to a changed meiofauna community structure. Nematode and juvenile polychaete abundance increased with increasing nutrient input, especially in early summer, whereas kinorhynchs, ostracods, harpacticoids, and juvenile bivalves decreased. The lack of a positive biomass response of the total meiofauna in the enriched tanks suggests that the meiofauna was limited not only by the availability of food, but also by biotic interactions. (Author's abstract)
W89-01033

USE OF FACTORIAL EXPERIMENTAL DESIGN TO EVALUATE HOW BIOTIC AND ABIOTIC FACTORS INFLUENCE CADMIUM ACCUMULATION IN THE UNICELLULAR ALGA DUNALIELLA BIOCULATA,
Paris-7 Univ. (France). Lab. de Cytophysiologie Vegetale et Toxicologie Cellulaire.
For primary bibliographic entry see Field 5B.
W89-01043

POTENTIAL IMPORTANCE OF SPATIAL AND TEMPORAL HETEROGENEITY IN PH, AL, AND CA IN ALLOWING SURVIVAL OF A FISH POPULATION: A MODEL DEMONSTRATION,
Oak Ridge National Lab., TN. Environmental Sciences Div.
J. E. Breck, D. L. DeAngelis, W. Van Winkle, and S. W. Christensen.
Ecological Modelling ECMODT, Vol 41, No. 1/2, p 1-16, April 1988. 5 fig, 38 ref.

Descriptors: *Water chemistry, *Water pollution effects, *Mathematical models, *Acid rain effects, *Hydrogen ion concentration, *Aluminum, Calcium, Fish populations, Chemical properties, Bioassay, Heterogeneity, Temporal distribution, Spatial distribution.

To provide a means of relating laboratory and field bioassay results to natural populations, an existing Monte Carlo method was modified to track the movement and survival of fish in a body of water, represented by a two-dimensional grid, subject to acidification stress. It was assumed that the fish are able to sense realistic gradients of pH, aluminum (Al), and calcium (Ca) (or alkalinity) and to move to reduce the chemical stress. A function for accumulation and repair of damage is implemented within the model to relate mortality to the variable exposure history the fish accumulate by moving in the chemically heterogeneous environment. Using the model, we evaluated the influence of the strength and sensitivity of fish avoidance behavior, the presence or absence of the refuge, and the

timing of multiple pulses on fish survival. The results highlight the potential importance of a chemically heterogeneous natural environment in allowing a population to survive under average water quality conditions that laboratory bioassays suggest should prohibit survival. Laboratory and field behavior experiments, including characterization of water chemistry on a microscale in the field, are suggested to explore this phenomenon further. (Author's abstract)
W89-01052

ORGANOCHLORINES AND EGGSHELL THINNING IN NORTHERN GANNETS (SULA BASSANUS) FROM EASTERN CANADA, 1968-1984,
National Wildlife Research Centre, Ottawa (Ontario).
J. E. Elliott, R. J. Norstrom, and J. A. Keith.
Environmental Pollution ENPOEK, Vol. 52, No. 2, p 81-102, 1988. 3 fig, 3 tab, 72 ref.

Descriptors: *Canada, *Quebec, *Eggs, *Water pollution effects, *Chlorinated hydrocarbons, *Water pollution effects, *Eggshell thinning, *Northern Gannetts, Sula bassanus, Productivity, Pollutants, DDE, DDD, DDT, Toxicity, Insect control, Dieldrin, Population dynamics, Chemical wastes, Radioactive half life, Polychlorinated biphenyls.

The northern gannets nesting on Bonaventure Island, Quebec, were studied from 1968 to 1984 in order to measure environmental contaminant levels and their relationship to productivity. Fresh eggs in 1969 contained a mean DDE level of 18.5 mg/kg and had shells which were 17% thinner than pre-1947 samples. Unhatched eggs in 1969 had no outer calcified layer, a mean thickness 20% less than the pre-1947 mean, and mean DDE concentration of 30.6 mg/kg. Significantly higher levels of eight contaminants were measured in unhatched than in fresh eggs collected in 1969. DDE and shell thinning were also intercorrelated with nine other contaminants; these data strongly implicate toxic chemicals, particularly DDE, as the main cause for the low breeding success of Bonaventure gannets from 1966 to 1974. Extensive use of DDT to control forest insects around the Gulf of St Lawrence ceased in 1969. Use of DDT, dieldrin and PCBs was restricted in North America during the early 1970s. Residues of DDT, DDD, DDE, PCBs, dieldrin, HCB and chlordane-related compounds in gannet eggs decreased significantly during this study. Heptachlor epoxide remained constant while alpha-HCH appeared to increase. Estimated half-lives ranged from 3.1 years for DDD to 35.4 years for oxychlordane. The breeding success and population of the colony have coincidentally increased. (Author's abstract)
W89-01054

ACUTE AND CHRONIC TOXICITY OF TRIPHENYLTIN HYDROXIDE TO FATHEAD MINNOWS (PIMEPHALES PROMELAS) FOLLOWING BRIEF OR CONTINUOUS EXPOSURE,
Environmental Research Lab.-Duluth, MN.
A. W. Jarvinen, D. K. Tanner, E. R. Kline, and M. L. Knuth.
Environmental Pollution ENPOEK, Vol. 52, No. 4, p 289-301, 1988. 1 fig, 2 tab, 27 ref.

Descriptors: *Toxicity, *Triphenyltin hydroxide, *Fathead minnows, *Water pollution effects, *Fungicides, *Pesticides, Minnesota, Water sampling, Lake Superior, Chemical analysis, Statistics, Hazardous materials, Ecological effects.

Fathead minnow larvae (Pimephales promelas) were exposed to triphenyltin hydroxide (TPTH) during single pulse or continuous exposure in 96 hour and 30 day toxicity tests. The continuous exposure 96 hour LC50 value was 7.1 micrograms/liter. Brief exposure for 12 to 72 hr gave 96 hour LC50 values that ranged from 61.8 to 6.0 micrograms/l. The continuous exposure 30 day chronic effect concentration, based upon reduced growth, was 0.23 micrograms/l. Survival was significantly reduced at 2.0 micrograms/l. Brief exposures for 24, 48, and 72 hr in 30 day tests significantly reduced survival and growth at 13.0, 13.0 and 60.0 micrograms/l. It is suggested that both toxicant concentration and exposure duration are important factors to consider in the risk assessment of potential pesticide hazards in the environment. (Author's abstract)
W89-01057

EFFECTS OF A SIMULATED ACID PRECIPITATION ON LEAF LITTER QUALITY AND THE GROWTH OF A DETRITIVORE IN A BUFFERED LOTIC SYSTEM,
Calgary Univ. (Alberta). Aquatic Ecology Section.
A. Garden, and R. W. Davies.
Environmental Pollution ENPOEK, Vol. 52, No. 4, p 303-313, 1988. 5 fig, 35 ref.

Descriptors: *Acid rain effects, *Environmental effects, *Water pollution effects, *Acid rain, *Litter, *Lotic environment, *Detritus, *Leaves, Ecology, Nitrogen, Ecosystem, Chemical analysis, Productivity, Respiration, Statistical analysis, Carbon, Biomass, Larvae.

The effects of a simulated acid rain on leaf litter quality and the growth of a detritivore in a buffered lotic system were investigated. Exposure of Populus balsamifera L. Saplings to a simulated acid precipitation prior to leaf abscission resulted in significant decreases in foliar nitrogen content and increases in carbon: nitrogen ratios. During decomposition of the leaf litter in a buffered lotic system, microbial activity was significantly reduced. Growth of Tipula commiscibilis Diane larvae decreased significantly when fed conditioned leaves exposed to a simulated acid precipitation prior to abscission. Reductions in detritivore growth were correlated with lower potential quality of the leaf litter resulting from increased carbon: nitrogen ratios and reduced levels of microbial activity. Thus, even in well buffered freshwater ecosystems, acid precipitation can have significant indirect effects on microbial activity and macroinvertebrate growth. (Author's abstract)
W89-01058

UTILITY OF LABORATORY STREAMS FOR ECOSYSTEM TOXICITY STUDIES,
Oregon State Univ., Corvallis. Oak Creek Lab. of Biology.
For primary bibliographic entry see Field 5B.
W89-01059

EFFECTS OF DISCHARGE FLUCTUATION AND THE ADDITION OF FINE SEDIMENT ON STREAM FISH AND MACROINVERTEBRATES BELOW A WATER-FILTRATION FACILITY,
California Univ., Berkeley. Dept. of Forestry and Resources Management.
D. C. Erman, and F. K. Ligon.
Environmental Management EMNGDC, Vol. 12, No. 1, p 85-97, 1988. 3 fig, 4 tab, 58 ref.

Descriptors: *Water treatment wastes, *Water pollution effects, *Fish, *Wastewater pollution, Sediments, Discharge measurement Streams, Macroinvertebrates, Filtration, San Pablo Creek, California, Drinking water, Toxicity, Aqueducts, Backwash, Varied flow, Trout, Stickleback, Sculpin, Species diversity.

A small, coastal stream in the San Francisco Bay area of California, received the discharges from a drinking water filtration plant. Two types of discharges were present. Discharges from filter backwashing were 3 to 4 times base stream flow, occurred 10 to 60 times per day, contained fine sediments, and each lasted about 10 minutes. The other discharge was a large, steady flow of relatively sediment-free water from occasional overflow of the delivery aqueduct which generally lasted several hours a day. Samples of invertebrates from natural substrates had significantly fewer taxa and lower density at the two stations below the backwash than at the two above. However, when stable artificial substrates were used, there were no significant differences among all four stations. The aqueduct apparently had no effect because the invertebrate community at the station upstream of the backwash but down stream of the aqueduct was statistically similar to the station above the aqueduct. Additional artificial substrates were exposed to short-term simulated backwash conditions to test for acute toxicity. The exposure had no effect on invertebrate density or drift. The major effect of the water treatment plant on fish and invertebrates probably was not from acute toxicity in the discharges or the occasionally large discharge of clean water from the aqueduct, but was from the fluctuating backwash flows containing fine sediment that displaced small fish downstream and created unstable benthic substrates for invertebrates. (Author's abstract)
W89-01061

EFFECTS OF CADMIUM ON EARLY DEVELOPMENTAL STAGES OF THE SHEEPSHEAD MINNOW (CYPRINODON VARIEGATUS),
Maryland Univ., Solomons. Center for Environmental and Estuarine Studies.
M. J. Meteyer, D. A. Wright, and F. D. Martin.
Environmental Toxicology and Chemistry ETOCDK, Vol. 7, No. 4, p 321-328, April 1988. 5 fig, 3 tab, 22 ref.

Descriptors: *Water pollution effects, *Cadmium, *Sheepshead minnow, *Environmental effects, *Eggs, *Larvae, *Hatching, Calcium, Phosphorus, Sodium, Chesapeake Bay, Maryland, Patuxent River.

Cadmium uptake by the early developmental stages of the sheepshead minnow, Cyprinodon variegatus, was studied over a 7.5-d post hatch period. After chorionic hardening, eggs were placed in filtered water from the Patuxent River, Maryland and dosed with cadmium concentrations of between 0.39 and 1020 microgram/L. At the highest cadmium concentrations studied, hatching was delayed up to 3 days and larvae had spinal deformities. Growth inhibition was not clearly dose-related, although larvae from all cadmium treatments were significantly shorter than control. The lowest dry weights were recorded from the 5.8 and 1020 micrograms Cd/L treatment groups. Cadmium uptake peaked at 12 h after fertilization. Inhibition of calcium uptake persisted even after cadmium levels had peaked and fallen to the control level. Phosphorus and sodium concentrations in eggs and larvae were not affected by cadmium exposure. 93% of the cadmium accumulated by the egg was associated with the chorion, and 68% of this could be removed by a glycine buffer. (Author's abstract)
W89-01091

EFFECTS OF ACUTE EXPOSURE TO ACIDIFIED WATER ON THE BEHAVORIAL RESPONSE OF FATHEAD MINNOWS, PIMEPHALES PROMELAS, TO ALARM SUBSTANCE (SCHRECKSTOFF),
Saskatchewan Univ., Saskatoon. Dept. of Biology.
R. J. F. Smith, and B. J. Lawrence.
Environmental Toxicology and Chemistry ETOCDK, Vol. 7, No. 4, p 329-335, April 1988. 1 tab, 36 ref.

Descriptors: *Water pollution effects, *Acid rain, *Fathead minnow, *Toxicity, *Environmental effects, *Fish behavior, Chemoreception, Hydrogen ion concentration, Ecology, Statistical analysis, Bioassay.

Fathead minnows, Pimephales promelas, exposed to acidified water for 72 hours continued to respond normally to the alarm substance (Schreckstoff) contained in water extracts of conspecific skin. This result contrasts with an earlier finding that some behavioral responses to chemical feeding stimuli are lost at relatively high pH levels (pH=6.0). In combination, the two sets of results indicate that different stimulus/response systems have different thresholds for interference by acidification. (Author's abstract)
W89-01092

ESTIMATING THE ACUTE TOXICITY OF WATERBORNE CHEMICALS IN TROUT FROM

MEASUREMENTS OF MEDIAN LETHAL DOSE AND THE OCTANOL-WATER PARTITION COEFFICIENT,
Department of Fisheries and Oceans, Burlington (Ontario). Great Lakes Fisheries Research Branch.
P. V. Hodson, D. G. Dixon, and K. L. Kaiser.
Environmental Toxicology and Chemistry ETOCDK, Vol. 7, No. 6, p 443-454, June 1988. 6 fig, 3 tab, 15 ref.

Descriptors: *Organic compounds, *Toxicity, *Trout, *Fish, *Median lethal dose, Quantitative analysis, Regression analysis.

Median lethal dose (LD50) and median lethal concentrations (LC50) for rainbow trout of 48 organic chemicals were measured to determine whether LC50 could be predicted from LD50. A simple linear regression of log-transformed data provided the best fit (r=-0.70), but it accounted for only 50% of the variability in LC50s. LC50s were also strongly correlated with measures of molecular size and of water-lipid partitioning. Hence, inclusion of these factors in a multiple regression analysis was examined. Since MW and Parachor were negatively correlated with LD50 (r=-0.61 and -0.60), they were not true independent variables and were not used. However, there was no relationship of octanol-water partition coefficient with LD50, and a multiple regression analysis using both LD50 and octanol water partition coefficient predicted LC50 with greater certainty than did either factor alone. Therefore, LC50 can be predicted from LD50 when partitioning of a chemical from water to lipid is recognized. (Author's abstract)
W89-01095

VOLUME FRACTION CORRELATION FOR NARCOSIS IN AQUATIC ORGANISMS: THE KEY ROLE OF PARTITIONING,
Toronto Univ. (Ontario). Inst. for Environmental Studies.
S. G. Abernethy, D. Mackay, and L. S. McCarty.
Environmental Toxicology and Chemistry ETOCDK, Vol. 7, No. 6, p 469-481, June 1988. 2 fig, 3 tab, 30 ref.

Descriptors: *Narcosis, *Aquatic animals, *Correlation analysis, *Toxicity, *Organic compounds, Physical analysis, Statistical analysis, Fathead minnow, Guppy, Brine shrimp, Golden orfe, Paramecium, Water flea, Chemical analysis.

A correlation approach was developed to describe narcosis in several aquatic species. By assuming that narcosis occurs as a result of a constant volume fraction of toxicant at the target site in the test organism, it is possible to correlate LC50s for a series of chemicals with their octanol-water partition coefficients and molar volumes. The approach was successfully tested on acute and chronic toxicity data from the published literature. Two hundred-fourteen toxicity determinations, with 113 different organic chemicals and involving fathead minnnow, guppy, golden orfe, water flea, brine shrimp, and paramecium, were employed. The data analysis suggests that partition coefficients of the chemicals between the target phase in the test organism and water are similar to, but generally lower than, octanol-water partition coefficients. The analysis also suggests a method of correlating the toxicities of mixtures and provides an explantion of the toxicity cut-off frequently observed in toxicity tests with chemicals of low water solubility. The interpretation provides insights into the role of partitioning in the acute and chronic effects of nonselective narcotic toxicants. (Author's abstract)
W89-01096

COMPARATIVE SENSITIVITIES OF BLUEGILL, CHANNEL CATFISH AND FATHEAD MINNOW TO PH AND ALUMINUM,
Carnegie Institution of Washington, Baltimore, MD. Dept. of Embryology.
R. E. Palmer, R. J. Klauda, and T. E. Lewis.
Environmental Toxicology and Chemistry ETOCDK, Vol. 7, No. 6, p 505-516, June 1988. 5 fig, 3 tab, 30 ref.

Descriptors: *Bluegill, *Fish, *Channel catfish, *Fathead minnow, *Acid rain effects, *Aluminum, *Hydrogen ion concentration, *Toxicity, Statistical analysis, Chemical analysis, Mortality.

Sensitivities of bluegill, channel catfish and fathead minnow to pH and aluminum were compared during 96-h acute toxicity tests in the laboratory. Juveniles were exposed to four HCl and five AlCl3 treatments in moderately soft fresh water under continuous flow-through conditions. The ranking of species sensitivities to acid alone was fathead minnow, followed by channel catfish and bluegill. Aluminum was not toxic to these species at pH 6.5 and 7.5. The ranking of sensitivities to Al at pH 4.5 and 5.5 showed clearer species differences. Fathead minnow were most sensitive and died in all Al treatments. Bluegill were least sensitive and died only in the highest Al concentration of pH 5.5. The sensitivity of channel catfish to Al was intermediate, but was most similar to that of fathead minnow. Aluminum, predominantly as hydroxide species, appeared to be most toxic to bluegill at pH 5.5. Free and hydroxy Al species were apparently toxic to fathead minnow and channel catfish at pH 4.5 and 5.5. The experimental data corroborate the observed distributions of these species in acidified lakes and streams. (Author's abstract)
W89-01098

SENSITIVITY OF FRESHWATER PULMONATE SNAILS, LYMNAEA LUTEOLA L., TO HEAVY METALS,
Industrial Toxicology Research Centre, Lucknow (India). Preventive Toxicology Div.
B. S. Khangarot, and P. K. Ray.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 41, No. 2, p 208-213, August 1988. 2 tab, 18 ref.

Descriptors: *Water pollution effects, *Aquatic animals, *Snails, *Heavy metals, *Toxicity, Sensitivity analysis, Food chains, Bioassay, Silver, Mercury, Copper, Cadmium, Nickel, Zinc, Lethal limit, Mortality, India, Bioindicators.

A study was undertaken to determine the acute toxicities of selected heavy metals to a locally-abundant pond snail which plays an important role in aquatic food chains. Static bioassays were conducted with the salts of cadmium, copper, chromium, mercury, nickel, silver, and zinc in hard water (195 mg/L as calcium carbonate) under ambient summer conditions (32 C). Ten snails at a time were exposed to each concentration and for every concentration there were two replicates. Seven to ten concentrations were tested for each metal. The dead specimens were removed and recorded at 1, 2, 4, 8, 14 plus or minus 2, 24, 33 plus or minus 3, 48, 72, and 96 hours. There was a marked and progressive decrease in LC50 values between 24 and 96 hours. The results suggested that Ag was the most toxic heavy metal and Cr the least toxic. Based on the concentration of metal ions that caused 50% mortality at 96 hours of exposure (96-h LC50), the decreasing order of toxicity of the metals was Ag > Hg > Cu > Ni = Cd = Zn > Cr. These results are compared with studies of the toxicity of heavy metals to some other freshwater animals, as reported in the literature. Pulmonate snails such as Lymnaea luteola are commonly available in Indian fresh-water reservoirs throughout the year. They can be easily handled and cultured in the laboratory and are sensitive indicators of harmful levels of environmental pollutants. (Shidler-PTT)
W89-01154

BRANCHIAL AND RENAL PATHOLOGY IN THE FISH EXPOSED CHRONICALLY TO METHOXY ETHYL MERCURIC CHLORIDE,
Kumaun Univ., Naini Tal (India). Dept. of Zoology.
T. S. Gill, J. C. Pant, and H. Tewari.
Bulletin of Environmental Contamination and Toxicology BECTA6. Vol. 41, No. 2, p 241-246, August 1988. 10 fig, 12 ref.

Descriptors: *Water pollution effects, *Pesticides, *Toxicity, *Methoxy ethyl mercuric chloride, *Fish, *Animal pathology, Gills, Kidneys, Animal tissues, Sublethal effects, Tissue analysis, Histology, Mercury.

Pathological manifestations causally related to pesticide poisoning have been described in both surficial and internal tissues of fish. The pathogenesis of branchial and renal lesions in the common freshwater fish, Puntius conchonius exposed chronically to sublethal levels of methyl ethyl mercuric chloride (MEMC) are described. Laboratory-acclimatized fish were exposed to a commercial formulation of MEMC at 3.6 and 6.0 ppm, representing 20 and 33% of the 96-hour LC50; a parallel control group of fish was maintained in toxicant-free tapwater. Batches of 8 to 10 individuals were sacrificed at the end of 7, 21, 35, and 56 days. The secondary gill lamellae in control fish were found to be slender and erect with an uninterrupted epithelium covering the pillar cells, and contained interspersed sinuses. Chronic MEMC intoxication caused drooping of secondary lamellae as well as capillary congestion. A 7-day exposure to 3.6 ppm MEMC led to formation of aneurysms containing intact or lysed red blood cells. In control fish the kidneys revealed intact renal tubules surrounded by extensive hematopoietic tissue and sinusoids. Following MEMC exposure for 7 days at 3.6 ppm, the tubular epithelial cells revealed pycnitic and karyorhectic nuclei and a disrupted luminal surface. The nephrotoxic effects of MEMC were primarily due to the presence of Hg, which has been shown to induce renal lesions in fishes. (Shidler-PTT)
W89-01156

EFFECTS OF SIMULATED ACIDIC PRECIPITATION ON PLANT-INSECT INTERACTIONS IN AGRICULTURAL SYSTEMS: CORN AND BLACK CUTWORM LARVAE,
Ohio Agricultural Research and Development Center, Wooster. Dept. of Entomology.
D. H. Stinner, B. R. Stinner, and D. A. McCartney.
Journal of Environmental Quality JEVQAA, Vol. 17, No. 3, p 371-376, July-September 1988. 3 fig, 3 tab, 44 ref.

Descriptors: *Air pollution effects, *Acid rain, *Simulated rainfall, *Crop production, *Insects, *Corn, Agriculture, Larval growth stage, Precipitation, Animal metabolism, Animal growth, Food habits, Insect behavior, Hydrogen ion concentration, Digestion, Acidity.

Effects of acidic precipitation (pH 2.8, 4.2, and 5.6) on food utilization, growth, development, and herbivory of fourth-, fifth-, and sixth-instar black cutworms (Agrotis ipsilon) on corn (Zea mays) in the most economically-important life-history combinations of plant and insect were investigated in a series of laboratory and greenhouse experiments. A nutritional-index technique was used in petri-dish experiments to determine if acid precipitation could affect the amount of food consumed via effects on insect physiological parameters. Larvae were fed corn plants that were watered two times weekly with simulated acidic precipitation until the larvae pupated (total deposition of 8-10 cm of precipitation). The inverse relationship between the 'index of approximate digestibility', which was higher in the pH 2.8 and 5.6 treatments, and the 'efficiency of conversion of digested food index', which was lowest in the pH 2.8 treatment, suggested a stress effect of high acidity. Six greenhouse pot experiments were conducted to assess direct effects of acid precipitation on black cutworms and their interactions with growing corn plants. Larvae were placed in pots containing soil and corn plants, which were initially in the first or second leaf stage, and simulated acid precipitation was applied two times per week until the larvae pupated (8-16 cm total deposition). Significant treatment effects were observed in the 'sixth instar larvae on two-leaf corn' experiment, where the larvae grew larger and developed faster in the pH 2.8 and 4.2 treatments than in the 5.6 treatment. Acid precipitation treatments did not significantly affect black cutworm damage to corn plants in any of these experiments. (Author's abstract)
W89-01160

TOXICITY OF ALKYLLEAD SALTS TO ANAEROBIC NITROGEN TRANSFORMATIONS IN SEDIMENT,
Macdonald Coll., Ste. Anne de Bellevue (Quebec). Dept. of Food Science and Agricultural Chemistry.
J. S. Blais, W. D. Marshall, and R. Knowles.
Journal of Environmental Quality JEVQAA, Vol. 17, No. 3, p 457-462, July-September 1988. 6 fig, 39 ref. Natural Sciences and Engineering Research Council of Canada Grants C0316 and A6687.

Descriptors: *Water pollution effects, *Lake sediments, *Lead, *Water pollution sources, *Biotransformation, *Toxicity, *Alkyl-lead chlorides, Inhibition, Denitrification, Nitrogen cycle, Anaerobic conditions, Nitrogen fixation, Acetylene reduction, Adaptation.

Four alkyl-lead chlorides (trimethyl-lead chloride, dimethyl-lead dichloride, triethyl-lead chloride, and diethyl-lead dichloride) were separately tested (at 0.1, 1, 5, and 10 micrograms/L) for their inhibitory properties against denitrification and nitrogen fixation in a lake sediment as determined by acetylene blockage and acetylene reduction techniques. In the presence of added nitrate, glucose, and acetylene, alkyl-lead salts only moderately inhibited nitrous-oxide, ethylene, and carbon-dioxide accumulation by whole-slurry incubations. These effects were more pronounced in supernatant than sediment. In general, ethyl leads were more toxic than methyl-lead salts and dialkyl leads were more inhibitory than their trialkyl homologs to these transformations. Successive incubations indicated that microbes were able to adapt to the presence of these toxicants, a phenomenon also observed with other heavy metals. At the highest concentrations which have been reported in sediments, no serious hazard to N transformations exists. (Author's abstract)
W89-01167

PHYTOPLANKTON AND REVERSED EUTROPHICATION IN LAKE MALAREN, CENTRAL SWEDEN, 1965-1983,
National Swedish Environmental Protection Board, Uppsala (Sweden). Environmental Quality Lab.
For primary bibliographic entry see Field 5G.
W89-01188

STREAM ACIDIFICATION TRENDS IN THE WELSH UPLANDS: A MODELLING STUDY OF THE LLYN BRIANNE CATCHMENTS,
Institute of Hydrology, Wallingford (England).
P. G. Whitehead, S. Bird, M. Hornung, J. Cosby, and P. Paricos.
Journal of Hydrology JHYDA7, Vol. 101, No. 1-4, p 191-212, June 30, 1988. 8 fig, 7 tab, 35 ref.

Descriptors: *Model studies, *Acid rain, *Acid streams, *Path of pollutants, *Water pollution effects, *Wales, Air pollution, Land use, Forest watersheds, Water pollution sources, Ammonia, Nitrates, Aluminum, Soil chemistry, Hydrologic models.

Historical reconstructions and predictions of streamwater acidification are presented for moorland and afforested catchments in the Welsh Uplands at Llyn Brianne. The model MAGIC (Model of Acidification of Groundwater in Catchments) is calibrated using data from a moorland catchment and validated by application to a forested catchment. While atmospheric deposition is shown to be the primary cause of stream acidification, conifer afforestation can enhance stream acidity. The historical trends determined by the model indicate that acidification has been present since the turn of the century and will continue unless either deposition levels are reduced significantly or other land management actions such as liming are undertaken on a major scale. (Author's abstract)
W89-01206

EVALUATION AND COMPARISON OF TWO SHORT-TERM FATHEAD MINNOW TESTS FOR ESTIMATING CHRONIC TOXICITY,
Environmental Monitoring and Support Lab.-Cincinnati, OH. Biological Methods Branch.
For primary bibliographic entry see Field 5A.
W89-01224

MODELING BLUE-GREEN ALGAL BLOOMS IN THE LOWER NEUSE RIVER,
Virginia Univ., Charlottesville. Dept. of Civil Engineering.
W. S. Lung, and H. W. Paerl.
Water Research WATRAG, Vol. 22, No. 7, p 895-905, July 1988. 7 fig, 1 tab, 30 ref. North Carolina Water Resources Research Institute Project 70025 and North Carolina Sea Grant Projects R/MER-1 and R/MER-5.

Descriptors: *Model studies, *Eutrophication, *Estuaries, *Algae, *Neuse River, *North Carolina, Water pollution effects, Water pollution control, Phytoplankton, Water quality, Mathematical models, Mass transport, Cyanophyta, Seasonal variation, River flow.

Over the past decade, segments of the lower Neuse River between Kinston and New Bern, NC revealed alarming symptoms of advanced eutrophication, culminating in the appearance and persistence of nuisance blue-green algal blooms. A mathematical model of the lower Neuse River was developed to help evaluate control alternatives, including nutrient control and flow control. The model included differentiation between four phytoplankton groups: diatoms, green algae, and blue-green algae (nitrogen-fixing and non-nitrogen-fixing). Other water-quality constituents modeled included nitrogen and phosphorus components and dissolved oxygen. The water column was partitioned into two layers and the associated mass-transport pattern was incorporated. The model was able to mimic the seasonal trends of algal-biomass, nutrient, and dissolved oxygen levels observed in 1983, 1984, and 1985, each year having a different hydrologic pattern. Comparison of model-calibration results suggested that freshwater flow and associated mixing conditions in the river play a major role in initiating and maintaining blue-green blooms when sufficient nutrient supplies are present. (Author's abstract)
W89-01225

ASSESSMENT OF SELENIUM TOXICITY IN ALGAE USING TURBIDOSTAT CULTURE,
Wisconsin Univ.-Milwaukee. Dept. of Biological Sciences.
W. N. Bennett.
Water Research WATRAG, Vol. 22, No. 7, p 939-942, July 1988. 2 fig, 1 tab, 13 ref.

Descriptors: *Water pollution effects, *Toxicity, *Bioassay, *Selenium, *Algae, *Culturing techniques, Continuous culture, Chlorella, Growth rates, Sublethal effects, Batch culture.

In a turbidostat culture system, the maximum specific growth rate of a Chlorella pyrenoidosa population was a dependent variable monitored in real time vs selenium (as sodium selenate) concentration. There was a near-linear decrease in steady-state growth rate in response to 4 selenium concentrations (control, 0.53, 0.90, and 1.37 micrograms/ml) with a growth-rate IC50 (toxin concentration which inhibits a growth parameter by 50%) of 0.80 micrograms selenium/ml at a sulfur concentration of 2.70 micrograms/ml. Transient changes in growth rate between steady states was also quantified using this system. Although the use of turbidostat culture for the assessment of toxicity in algae and zooplankton is structurally more complex than batch culture, the quality of information gained, especially on transient growth responses and rates of recovery and adaptability, justifies the technical complexity. (Author's abstract)
W89-01230

LAKE RESPONSE MODELING USING BIOLOGICALLY AVAILABLE PHOSPHORUS,
S. R. Butkus, E. B. Welch, R. R. Homer, and D. E. Spyridakis.
Journal--Water Pollution Control Federation JWPFA5, Vol. 60, No. 9, p 1663-1669, September 1988. 10 fig, 18 ref.

Descriptors: *Lakes, *Model studies, *Chlorophyll a, *Transparency, *Eutrophication, *Phosphorus, *Urban runoff, Washington State, Bioassay, Statistical analysis, Nutrients, Seasonal variation, Data interpretation.

Biologically-available phosphorus (BAP) was determined monthly for a year in Lake Sammamish, WA, and its principal inflow stream, to improve on previously-developed relationships between total phosphorus (TP) from increased urban runoff and lake response (chlorophyll a and transparency). Relationships were developed between bioassay-determined BAP and a combination of soluble reactive P and NaOH-extractable P. These relationships were consistent whether from Lake Sammamish monthly samples plus summer samples from 29 other lakes (r squared = 0.80) or from the inflow stream (r squared = 0.82). Seasonal changes in BAP were predicted slightly more reliably than TP, using a mass-balance model and a 10-year dataset. Also, a linear, arithmetic relationship between spring BAP and summer chlorophyll a represented the best fit of past data (r squared = 0.84, n = 11) and is more reliable than published log-log, TP/chlorophyll a relationships for predicting the specific response of Lake Sammamish to increased urban runoff. (Author's abstract)
W89-01236

SAMPLING STRATEGIES AND ASSOCIATED ERRORS IN ESTIMATING EPILIMNETIC CHLOROPHYLL IN EUTROPHIC LAKES,
Wisconsin Univ.-Madison. Water Chemistry Lab.
For primary bibliographic entry see Field 2H.
W89-01242

WINTER CLOUD WATER AND AIR COMPOSITION IN CENTRAL ONTARIO,
Atmospheric Environment Service, Downsview (Ontario).
J. W. Strapp, W. R. Leaitch, K. G. Anlauf, J. W. Bottenheim, and P. Joe.
Journal of Geophysical Research (D) JGRDE3, Vol. 93, No. 4, p 3760-3772, April 20, 1988. 8 fig, 3 tab, 46 ref.

Descriptors: *Water pollution sources, *Acid rain, *Cloud water, *Sulfur dioxide, *Nitric acid, Nitrates, Sulfates, Air pollution, Pollutants, Precipitation, Ontario, Canada, Clouds, Aerosols.

Time histories of surface air composition and cloud water composition in winter in central Ontario were compared in order to establish a winter data set for this region, and to identify dominant processes responsible for the incorporation of sulfate, nitrate, and acidity into cloud water. Cloud water comparisons were restricted to low-level collections (median altitude 625 m above ground) within the boundary layer. Surface level measurements during the 6-week period showed a variety of conditions, including several episodes of elevated concentrations of SO2, NO3(-), HNO3, aerosol SO4(--), and occasionally aerosol NO3(-). Nitric acid comprised the majority of soluble acidity at ground level more than half the time, and was relatively more important during the periods of elevated SO4(--) and NO3(-) concentrations. Examination of cloud water acidity indicated that HN03 was also the dominant contributor to cloud water acidity on the majority of days sampled. Comparisons of air and cloud water absolute concentrations and concentration ratios suggest that aqueous SO2 oxidation was of minor importance in determining cloud composition. The conclusion is supported by measurement of hydrogen peroxide in cloud water samples. Cloud water NO3(-)/SO4(--) ratios were found to exceed (HNO3 + NO3(-)/SO4(--) ratios in air at the surface in most cases, and in a few instances cloud water NO3(-) concentrations were higher than expected based on the surface air composition data; several possible causes for this observation are discussed. It is concluded that in this region in winter, the composition of low-level clouds can be estimated to within a factor of 2 by measurements of air composition at the surface, and that dissolution of soluble aerosol and gaseous species is primarily responsible for cloud composition. In-cloud SO2 oxidation is

found to be of minor significance, but the data may indicate in-cloud production of HNO3 in some cases. (Author's abstract)
W89-01265

5D. Waste Treatment Processes

MULTI-COMPONENT SORPTION ISOTHERMS OF BASIC DYES ONTO PEAT,
Queen's Univ., Belfast (Northern Ireland). Dept. of Chemical Engineering.
S. J. Allen, G. McKay, and K. Y. H. Khader.
Environmental Pollution ENPOEK, Vol. 52, No. 1, p 39-53, 1988. 11 fig, 4 tab, 10 ref.

Descriptors: *Dyes, *Peat, *Adsorption, *Isotherms, *Wastewater treatment, Equilibrium, Mathematical equations, Ions, Particulate matter, Photometry, Spectrophotometry, Wastes, Industrial wastes, Dye industry wastes.

The adsorption of basic dyes onto peat from single component and multi-component solutions was studied using sphagnum peat moss from Northern Ireland and three dyes with a range of concentrations. The Freundlich, Langmuir, and Redlich-Peterson isotherm equations were fitted to the results and the isotherm constants obtained. Results indicated a certain element of preferential adsorption. The extent of adsorption of any one dye was reduced when in the presence of one or more competing dyes. The equilibrium isotherms deviated from theory, due to the pressure of adsorbing ions creating new surfaces by expanding the adsorbent particles. It is concluded that an understanding of the physical implications of deviation from traditional theories will yield information on the sorption characteristics of particular solute species with specific adsorbents. Such information will play a vital part in the design of adsorbents for color removal from effluent streams. Attempts to use the adsorption of dyes on solids to determine specific surface areas of the adsorbent will be influenced by the swelling and penetration limitations of the materials concerned. (Doria-PTT)
W89-00083

EFFECTS OF A CYPERUS PAPYRUS L. SWAMP ON DOMESTIC WASTE WATER,
Mwanza Fisheries Research Centre (Tanzania).
F. M. M. Chale.
Aquatic Botany AQBODS, Vol. 23, No. 2, p 185-189, November 1985. 1 tab, 9 ref.

Descriptors: *Wastewater renovation, *Swamps, *Papyrus, *Domestic wastes, *Wastewater disposal, Nutrient removal, Temperature, Conductivity, Dissolved oxygen, Water quality, Kenya.

The effectiveness of a papyrus swamp for the removal of nutrients from domestic waste water was investigated in a small tropical swamp in Kenya. The study was conducted in a man-made impoundment transformed into a swamp which receives sewage effluents discharged into a stream. Spatial and temporal distribution of nutrients were determined in the swamp from October 1980 to August 1981. They included the measurement of nitrogen and phosphorus, together with temperature, pH, conductivity, and dissolved oxygen. A comparison between the water-quality characteristics of the input versus the output from the swamp indicated significant decreases in the mean temperature and conductivity by 20 and 23%, respectively. Dissolved oxygen was reduced by 85%, ammonium by 77%, and orthophosphate by 80%. The results indicate that papyrus swamps are efficient in nutrient removal for the purpose of domestic waste-water renovation. (Author's abstract)
W89-00107

CHROMIUM REMOVAL FROM WATER BY THREE SPECIES OF DUCKWEEDS,
Louisiana State Univ., Baton Rouge. Dept. of Forestry and Wildlife Management.
R. P. Staves, and R. M. Knaus.
Aquatic Botany AQBODS, Vol. 23, No. 3, p 261-273, December 1985. 2 fig, 3 tab, 37 ref.

Descriptors: *Floating plants, *Chromium, *Duckweeds, *Biological wastewater treatment, Plant growth, Radioactive tracers, Absorption, Tolerance, Bioaccumulation.

The effects of exogenous chromium on the growth of three species of duckweeds (Spirodela punctata, S. polyrhiza, and Lemna gibba) were examined at Cr concentrations ranging from 0.1 to 20 ppm. Using 51Cr radiotracer methodology, it was demonstrated that sorption was directly related to ambient Cr concentrations after 8 days of exposure. At and above 1.0 ppm Cr, negative effects on growth were evident, with seasonal variations apparently also affecting Cr uptake and toxicity. Chrome tolerance, based on the percentage of control growth achieved by exposed plants, showed S. polyrhiza to be the least tolerant to Cr, while S. punctata and L. gibba were more tolerant at concentrations above 1.0 ppm. In another experiment, duckweeds grown in nutrient-rich water with an initial concentration of 10 ppm exhibited substantial growth, with bioaccumulation of Cr increasing with time. The possible use of various types of biological treatment systems for the removal of Cr from wastewater is discussed. (Author's abstract)
W89-00109

ANIMAL WASTES MEDIA FOR SPIRULINA PRODUCTION,
Chile Univ., Santiago. Inst. de Nutricion de los Alimentos.
F. Ayala, and R. Bravo.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 67, No. 3, p 349-355, June 1984. 1 fig, 3 tab, 22 ref.

Descriptors: *Cyanophyta, *Spirulina, *Biological wastewater treatment, *Wastewater treatment, *Nitrogen, *Algal growth, *Animal wastes, *Farm wastes, *Wastes, Anaerobic digestion, Effluents, Biomass, Biodigestion, Nutrients, Proteins, Photosynthesis, Manure, Urine, Cultures, Wastewater treatment.

The effect of nutrient concentrations on growth, biomass yield and nitrogen efficiency conversion of a proteinaceous blue-green microalga (cyanobacterium), Spirulina maxima, were studied. An intensive culture was performed using liquor effluents from the anaerobic biodigestion of animal wastes (manure and urine from pig, beef cattle and sheep). Under environmental light and room temperature conditions, a dry biomass yield ranging between 795 and 1230 mg/l was obtained. The nitrogen efficiency conversion was 24 to 27% in the synthetic medium and about 65% in the animal-waste media. Spirulina might therefore be used as an effective photosynthetic agent for nutrient recovery from animal wastes. (Author's abstract)
W89-00136

INSTRUMENTATION FOR 7-DAY CONTINUOUS CYCLE MONITORING OF METALS WITH AUTOMATED ON-LINE SAMPLE PREPARATION, HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY, AND ELECTROCHEMICAL DETECTION,
Deakin Univ., Melbourne (Australia). Div. of Chemical and Physical Sciences.
For primary bibliographic entry see Field 5A.
W89-00210

MEASUREMENT OF PRIMARY PRODUCTIVITY IN A HIGH-RATE OXIDATION POND (HROP),
Bar-Ilan Univ., Ramat-Gan (Israel). Dept. of Life Sciences.
For primary bibliographic entry see Field 2H.
W89-00213

TESTING THE SECONDARY TREATMENT OF EFFLUENTS FROM THE 'POLICE' CHEMICAL PLANT IN CARP PONDS,
Akademia Rolnicza w Szczecinie (Poland). Dept. of Hydrobiology.
B. Szlauer, and L. Szlauer.
Polskie Archiwum Hydrobiologii PAHYA2, Vol. 34, No. 1, p 135-145, 1987. 1 fig, 7 tab, 9 ref.

Descriptors: *Effluents, *Chemical wastewater, *Fish ponds, *Aquaculture, *Water resuse, *Microponds, *Carp, *Wastewater treatment, *Secondary wastewater treatment, Cycling nutrients, Phosphorus removal, Culturing techniques, Field tests, Crop yield, Fish.

Preliminarily cleaned chemical effluents, utilized as a medium for carp rearing in ponds lost 80% PO4(3-) and 40% NH4(-)-N after 30 days of retention. These and other results obtained from ponds corroborated well with the results of earlier experiments carried out in field microponds of 1 cu m volume. This permits prediction of the effects of fish culture and effluent treatment in large ponds on the basis of easily done experiments in field microponds. (Author's abstract)
W89-00255

SIMULTANEOUS REMOVAL OF HEAVY METAL IONS FROM WASTEWATER BY FOAM SEPARATION TECHNIQUES,
National Tsing Hua Univ., Hsinchu (Taiwan). Dept. of Chemistry.
S.-D. Huang, M.-K. Huang, J.-Y. Gua, T.-P. Wu, and J.-Y. Huang.
Separation Science and Technology SSTEDS, Vol. 23, No. 4 and 5, p 489-505, April 1988. 9 fig, 8 tab, 16 ref.

Descriptors: *Foam separation, *Wastewater treatment, *Heavy metals, *Chemical precipitation, *Chemical treatment, Performance evaluation, Cobalt, Chromium, Nickel, Coper, Zinc, Cadmium, Lead, Ferric hydroxide, Aluminum hydroxide, Sodium lauryl sulfate, Wastewater, Ions, Metals, Colloids.

The present work aimed to extend the application of adsorbing colloid flotation techniques to remove mixtures of metal ions. The systems studied are: (1) Co(II) and Cr(VI); (2) Co(II), Ni(II), and Cr(VI); (3) Cr(VI), Cu(II), and Zn(II); (4) Cr(VI), Cu(II), Zn(II), and Ni(II); (5) Cd(II), Pb(II), and Cu(II). Ferric hydroxide and aluminum hydroxide were used as the coprecipitant, and sodium lauryl sulfate was used as the collector and frother. The ionic strength of the solution was adjusted with NaNO3 or Na2SO4. All the heavy metals can be removed effectively by a single-step foam flotation treatment. (Author's abstract)
W89-00265

COTTON YARN AND FABRIC FINISHING WASTEWATER TREATMENT IN UPFLOW ANAEROBIC FILTER,
Patras Univ. (Greece). Dept. of Chemistry.
N. Athanasopoulos, and T. Karadimitris.
Biotechnology Letters BILED3, Vol. 10, No. 6, p 443-444, June 1988. 5 ref.

Descriptors: *Textile mill wastes, *Anaerobic digestion, *Wastewater treatment, *Biological oxygen demand, Pollution load, Organic compounds, Biogas, Toxicity, Economic aspects, Industrial wastewater, Chemical oxygen demand, Wastewater, Cost analysis, Cotton.

Removal of COD for loadings up to 0.8 kg COD/cu m day varied from 66 to 80% and for higher COD loadings was approximately 50%. Removal of BOD5 for loadings higher than 0.8 kg COD/cu m day was also 50%. Volatile fatty acids remained low at 100-150 mg/L. Biogas production varied at 0.2-0.4 L/g influent COD and up to 20 L/day for loading up to 1 kgr COD/cu m day. When COD loading increased to 1.3 kg/cu/m day biogas production decreased gradually and stopped after a month. During this research toxicity problems of methane fermentation were not encountered. The achievable COD loading for a practical COD removal is very low. The investment cost for a rough treatment of cotton textiles finishing wastewater in an upflow filter is very high and the process is not applicable. Now a 2 cu m anaerobic fluidized bed reactor is under study as a method to achieve higher COD loading. (Alexander-PTT)
W89-00277

MULTICRITERION SELECTION OF WASTEWATER MANAGEMENT ALTERNATIVES,
Arizona Univ., Tucson. School of Renewable Natural Resources.
A. Tecle, M. Fogel, and L. Duckstein.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 114, No. 4, p 383-398, July 1988. 9 tab, 22 ref, 2 append.

Descriptors: *Wastewater management, *Decision-making, *Nogales, *Arizona, *Sonora, *Mexico, Computer programs, Mathematical analysis, Wastewater treatment, Case studies.

Multicriterion decision-making (MCDM) techniques were used to analyze a multiobjective wastewater management problem in order to select an appropriate management scheme. A specific case study consisting of 15 alternative management schemes was evaluated with respect to 12 noncommensurable, discrete criteria, using three different MCDM techniques: compromise programming (CP), cooperative game theory (CGT), and ELECTRE I. The case study is the Nogales International Wastewater Management Project, which treats wastewater coming from the twin cities of Nogales, Arizona and Nogales, Sonora, Mexico. The problem is formulated in a multicriterion context in terms of objectives, specifications, criteria, criterion scales, and construction of an evaluation matrix that consists of the alternative versus criteria array. Analyses of the matrix using the MCDM techniques result in selecting the most satisfying alternative in the case of CP and CGT and narrowing the choice to a few non-dominated alternatives (here, two) in the case of ELECTRE I. (Author's abstract)
W89-00300

WATER/WASTEWATER FACILITIES GET BETTER WITH ELECTRONICS,
Groveland Community Services District, CA.
B. Hill.
Water Engineering and Management WENMD2, Vol. 135, No. 6, p 34-35, 41, June 1988. 2 fig.

Descriptors: *Wastewater treatment, *Wastewater management facilities, *Computers, *Electronics, Water treatment facilities, Groveland, Seasonal variation, Microcomputers, California, Telemetry, Monitoring, Remote sensing.

The small community of Groveland, California has faced numerous challenges in its efforts to achieve reliable water and wastewater services. Most important, the mountainous terrain requires an unusually complex network of pump stations, tanks, and wastewater lift stations to serve its rapidly-growing seasonal population. This, coupled with a limited maintenance budget, and a small staff, makes Groveland a candidate for a supervisory control and data acquisition (SCADA) system. Considering the critical nature of the two systems and the health hazards associated with any failure in the wastewater collection system, the district recognized the need for telemetry monitoring early in its construction planning. The district began to investigate new microcomputer based SCADA systems with remote telemetry units (RTUs) that would provide them with full supervisory control of the lift stations as well as the simple monitoring functions they already had. Budget constraints, and the need to maintain continuity, prevented them from simply abandoning the old system and awarding a contract for design and construction of a new one. SCADA software is the The system developed for Vgoveland uses the Apple Macintosh Plus microcomputer, Harmony SCADA softwate (Darvish System), and RTUs from Rugid computers. It features simplified operation audible and visible alarms, and historical logging and trending. The alarm log provides a basis for preventive maintenance schedule adjustment, and equipment replacement or upgrade. For the wastewater treatment plant, the city ordered the same unit expanded to include 16 twelve-bit analog inputs and 48 digital inputs. By February, 1987, the system was in full operation. (Lantz-PTT)
W89-00392

SELECTED DYES FOR RESIDENCE TIME DISTRIBUTION EVALUATION IN BIOREACTORS,
Universidad Nacional Autonoma de Mexico, Mexico City. Inst. de Ingenieria.
B. Jimenez, A. Noyola, and B. Capdeville.
Biotechnology Techniques, Vol. 2, No. 2, p 77-82, June 1988. 1 fig, 2 tab, 11 ref.

Descriptors: *Biological wastewater treatment, *Wastewater treatment, *Tracers, *Dyes, *Spectrophotometry, Residence time distribution, Hydrogen ion concentration, Bromocresol green, Bromophenol blue, Dextran blue, Eosin y, Maordant violet, Bromophenol red, Phenol red, Methylene violet.

Based on a literature review and experimental results, some dyes well suited for residence time distribution evaluation in biological processes. The collection of dyes, which falls into two categories, is suited for tracer studies in bioreactors used specifically for wastewater treatment. The following dyes seem to be adequate for common biochemical engineering processes: (1) bromocresol green, (2) bromophenol blue, (3) dextran blue, (4) eosin Y, and (5) mordant violet. These substances showed no adsorption on biomass, stability in time, good solubility and no color change between pH 6.5 to 8.5 and can, therefore, be used with confidence. A second group is formed by dyes which might be used in special cases: (1) bromophenol red, if the pH is not between 5 and 6.8, (2) phenol red, if the pH is not between 6.8 and 8.4, and (3) methylene violet (Bernsthen), if a large quantity is used to obtain precise readings. (Miller-PTT)
W89-00404

GROWTH KINETICS OF HYDROXIDE FLOCS,
British Aerospace Aircraft Group, Kingston upon Thames (England).
For primary bibliographic entry see Field 5F.
W89-00428

LAND APPLICATION OF DOMESTIC WASTEWATER, WOOD PRODUCTION, AND SLUDGE COMPOSTING: AN ECONOMIC AND ENERGY PRODUCTION ANALYSIS,
Nebraska Univ.-Lincoln. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5E.
W89-00465

SIMULTANEOUS GAS CHROMATOGRAPHIC DETERMINATION OF NITROBENZENE AND 2,4-DINITROPHENOL IN NITROBENZENE MANUFACTURING PLANT WASTEWATER,
Institute of Science, Bombay (India). Dept. of Analytical Chemistry.
For primary bibliographic entry see Field 5A.
W89-00479

DYNAMIC MODELING OF PRIMARY SEDIMENTATION,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
P. Lessard, and M. B. Beck.
Journal of Environmental Engineering (ASCE) JOEDDU, Vol. 114, No. 4, p 753-769, August 1988. 5 fig, 3 tab, 26 ref, append.

Descriptors: *Wastewater treatment, *Statistical models, *Primary wastewater treatment, *Model studies, *Sediment concentration, Suspended sediments, Chemical oxygen demand, Nitrogen compounds, England.

A simple, lumped-parameter model was developed with reference to an intensive, 10-day experiment at the Norwich Sewage Works in eastern England. The model successfully quantified the interactions among essentially five state variables: total suspended solids, volatile suspended solids, total chemical oxygen demand (COD), soluble COD, and ammonium-N concentrations. It provided insight into the settling characteristics of different substances in different forms of sewage, and it illuminated the capacity for soluble COD removal and ammonium-N release in the sedimentation unit. It is concluded that specialized experimentation, with an appropriately-fast sampling frequency of observation, is crucial in identifying wastewater-treatment-process dynamics. (Author's abstract)
W89-00483

MOVEMENT OF SLUDGE THROUGH CONVEYOR CENTRIFUGE,
Duke Univ., Durham, NC. Dept. of Civil and Environmental Engineering.
P. A. Vesilind.
Journal of Environmental Engineering (ASCE) JOEDDU, Vol. 114, No. 4, p 784-791, August 1988. 6 fig, 3 ref.

Descriptors: *Wastewater treatment, *Sludge, *Sludge drying, *Wastewater facilities, *Centrifugation, Sludge thickening, Mathematical analysis, Design criteria, Design standards.

Conveyor centrifuges are widely used for dewatering wastewater sludges. The process requires that sludge be first settled out in the bowl under centrifugal acceleration and then moved by means of an internal conveyor up a beach and out of the machine. The movement of the sludge in the machine has never been observed, and its true path is unknown. Three possible paths for the sludge in a centrifuge are presented and the most likely mode of movement is suggested. The eventual determination of the true path will have implications for design and future development of centrifugal dewatering practice. (Author's abstract)
W89-00485

AMMONIA NITROGEN REMOVAL IN ATTACHED-GROWTH PONDS,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Environmental Engineering.
H. K. Shin, and C. Polprasert.
Journal of Environmental Engineering (ASCE) JOEDDU, Vol. 114, No. 4, p 846-863, August 1988. 3 fig, 5 tab, 22 ref.

Descriptors: *Wastewater treatment, *Ammonia, *Nitrogen removal, *Biological wastewater treatment, *Stabilization ponds, Kinetics, Growth media, Absorption, Biomass, Regression analysis.

Experiments on attached-growth waste-stabilization ponds (AGWSP) were conducted to evaluate the efficiencies, mechanisms, and kinetics of ammonia-nitrogen removal in AGWSP units. Laboratory-scale experiments demonstrated that ammonia-nitrogen removal was enhanced in the AGWSP units compared to treatment in control units without attached-growth media. The main mechanism of ammonia-nitrogen removal in the AGWSP units was found to be through biological uptake of ammonia nitrogen by the attached and dispersed biomass, while volatilization and nitrification had little effect on ammonia-nitrogen removal. Regression equations of various ammonia-nitrogen removal rates in AGWSP were developed and validated with data from the pilot-scale AGWSP experiments and some field-scale waste stabilization ponds. Applications of the experimental data and of the AGWSP are discussed. (Author's abstract)
W89-00489

REMOVAL OF CADMIUM USING CHITOSAN,
Intergovernmental Oceanographic Commission, Paris (France).
I. N. Jha, L. Iyengar, and A. V. S. Prabhakara Rao.
Journal of Environmental Engineering (ASCE) JOEDDU, Vol. 114, No. 4, p 962-974, August 1988. 11 fig, 4 tab, 16 ref.

Descriptors: *Wastewater treatment, *Sorption, *Cadmium, *Chitosan, Particle size, Hydrogen ion concentration, Chlorides, Zinc, Calcium, Magnesium, Bicarbonates, Regeneration.

Cadmium-removal efficiency from aqueous solutions was studied using batch experiments. The studies indicated that sorption kinetics as well as capacity favored using chitosan as an adsorbent. There was a significant increase in sorption capac-

ity with a decrease in chitosan particle size. Cadmium removal was pH-dependent and increased up to pH 8.3. The presence of chloride ion and ionic strength had no significant effect. Heavy-metal ions such as zinc and soluble complexing agents such as EDTA (ethylenediamine tetracetate) decreased the sorption of cadmium. Used chitosan can be regenerated with acid and reused. Column studies using cadmium-spiked tap water showed that the presence of calcium, magnesium, bicarbonate, and chloride ions in tap water did not affect the cadmium-removal capacity of chitosan. (Author's abstract)
W89-00496

APPARATUS FOR ASSESSING SULFIDE GENERATION RATES FROM SEWER SLIMES,
Monash Univ., Clayton (Australia). Faculty of Engineering.
J. Hauser, and G. A. Holder.
Journal of Environmental Engineering (ASCE) JOEDDU, Vol. 114, No. 4, p 977-987, August 1988. 3 fig, 1 tab, 3 ref.

Descriptors: *Wastewater analysis, *Measuring instruments, *Sulfides, *Slime, Industrial wastes, Pulp wastes, Wastewater outfall, Hydrogen ion concentration, Biological oxygen demand, Chemical oxygen demand.

The prediction of sulfide production from sewage that contains a substantial proportion of industrial waste is particularly difficult because industrial wastes span a wide range of chemical compositions. A rotating-drum reactor is described that can be conveniently used to measure sulfide generation and buildup. The general procedure for its use is outlined by summarizing an investigation of the relative contribution made by industrial sewage from a paper-mill complex to sulfide-buildup problems at the exit from a 45-km filled sewer. All tested sewages achieved their maximum sulfide-generation rate at slime depths < 1000 microns. The effects of parameters (such as pH) which are not incorporated into the existing predictive equations can be determined using the apparatus; because it is convenient to use, parameters such as temperature, BOD, and COD could be readily investigated. Studies similar to those described can be used to provide information that will assist in specifying items such as pretreatment requirements (e.g., pH adjustment), allowable industry discharge levels, costs to the discharger, and potential for damage to a sewerage system. (Shidler-PTT)
W89-00497

PERFORMANCE OF VINYL CORE MEDIA TRICKLING FILTER PLANT FOR SECONDARY TREATMENT OF MUNICIPAL WASTEWATER,
Cleveland State Univ., OH. Dept. of Geological Sciences.
H. H. Lo, and Y.-T. Hung.
Zeitschrift fuer Wasser und Abwasser-Forschung ZWABAQ, Vol. 21, No. 2, p 50-55, April 1988. 9 fig, 8 tab, 9 ref.

Descriptors: *Secondary wastewater treatment, *Filtration, *Wastewater treatment, *Municipal wastewater, *Vinyl core media, Trickling filters, Suspended solids, Biochemical oxygen demand, Pollutants, Effluents, Rivers, Performance evaluation.

A full scale vinyl core media trickling filter plant was evaluated to determine its effectiveness in removing pollutants from municipal wastewaters. The treatment plant is located in Zanesville, Ohio, and discharges its treated effluent into Muskingum River. Total suspended solids, and biochemical oxygen demand (BOD) in wastewater from different stages of treatment for a 9 year period from 1975-1983 were used in the determination of treatment performance. Results indicate that vinyl core media trickling filter plants can be used effectively as a secondary treatment process for municipal wastewater. The removal efficiency for total organic carbon and BOD was about 90%. The total suspended solids and BOD concentrations in the wastewater decreased as degree of treatment increased. The river diluted the treated effluent to a concentration of about 0.1 mg/l for total suspended solids and BOD throughout the year. (Author's abstract)
W89-00502

FUNDING RESERVE CAPACITY IN WASTEWATER SYSTEMS,
Metropolitan Waste Control Commission, St. Paul, MN.
R. A. Odde, and W. K. Johnson.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 5, p 602-607, May 1988. 5 fig, 3 tab, 1 ref.

Descriptors: *Wastewater management, *Capacity, *Financing, *Wastewater treatment, *Management planning, *Regional planning, *Pricing, Reserve capacity, Sewer systems, Planning, State Jurisdiction, Minnesota.

In 1969 the Metropolitan Waste Control Commission was established as the regional authority for wastewater treatment and collection in the 7-county metropolitan area of Minneapolis-St. Paul by the Minnesota State Legislature. The Metropolitan Waste Control Commission provides wastewater collection and treatment service for 105 communities with a sewered population of 1.87 million. A study of rate structure for service availability charge for years 1986-2010 was conducted by Metropolitan Waste Control Commission to examine factors that affect the long-range impact on the service availability charge system in financing the reserve capacity debt service. The study provided a planning document to guide the Metropolitan Waste Control Commission in establishing future service availability charge rates that are moderate and acceptable to new system users. The study should be updated at least biennially to consider changes in the service availability charge requirement and revenue. The service availability charge system of paying reserve capacity debt has worked for the Metropolitan Waste Control Commission and it is intended to continue with this system for the immediate future. (Hammond-PTT)
W89-00506

DEVELOPER FINANCING OF PUBLIC WASTEWATER SERVICE INFRASTRUCTURE,
J. M. Hurley.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 5, p 608-613, May 1988. 2 tab, 6 ref.

Descriptors: *Wastewater treatment, *Management planning, *Wastewater management, *Financing, Sewer systems, Construction, Local government, Maryland.

With changes in the roles of federal, state, and local governments relative to infrastructure financing and the shift to greater use of public-private partnerships, developer financing has surfaced as an important means of providing major off-site public facilities for new development. In pursuit of the developer financing alternative, Anne Arundel County, Maryland, has defined terms for contract negotiations. The county has negotiated agreements with developers that go beyond the traditional requirement for developers to construct and dedicate the on-site sewer lines necessary to serve their projects. The developers also have been called on to finance the construction of major off-site facilities needed to provide wastewater service not only to the projects but to future development as well. The experience of Anne Arundel County with developer financing of wastewater conveyance and treatment facilities has been positive and mutually beneficial for both the private interests involved and the community at large. (Hammond-PTT)
W89-00507

INNOVATIVE SEPTIC SYSTEM MANAGEMENT,
Environmental Protection Agency, Washington, DC. Office of Policy, Planning and Evaluation.
C. J. Prins, and K. W. Lustig.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 5, p 614-620, May 1988. 15 ref.

Descriptors: *Wastewater treatment, *Septic tanks, *Path of pollutants, *Groundwater pollution, *Environmental protection, *Planning, Potable water, Effluents, Septic wastewater, Water pollution control, Aquifers, Idaho.

Poorly installed and maintained septic systems pose a serious threat to groundwater quality, particularly in areas of high housing density. These dangers led the Panhandle Health District to establish an innovative septic system management program for Kootenai County, Idaho, to protect the water quality supplied by the Rathdrum Prairie Aquifer. The regulations provided a basis for managing growth, consistent with both economic and environmental needs. Sewage Management Agreements between the Panhandle Health District and individual cities tailor requirements to fit specific local circumstances in a way that encourages alternative proposals from cities and cooperative thinking. The Sewage Management Agreements have served as an effective vehicle for strengthening local environmental management through long-range land-use planning. Strong public education and extensive public participation in the Panhandle Health District strategy development for septic systems were important for its acceptance. The Panhandle Health District approach illustrated the central importance in undertaking a program of first educating the public and then inviting public participation. The process has resulted in a partnership between local and regional government that provides sufficient flexibility for local self-determination, while accomplishing regional goals for wastewater management. (Hammond-PTT)
W89-00508

REMOVAL OF PENTACHLOROPHENOL IN MUNICIPAL ACTIVATED SLUDGE SYSTEMS,
Environmental Protection Service, Burlington (Ontario). Waste Water Technology Centre.
H. Melcer, and W. K. Bedford.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 5, p 622-626, May 1988. 3 fig, 6 tab, 14 ref.

Descriptors: *Activated sludge process, *Wastewater treatment, *Pentachlorophenol, *Municipal wastewater, Phenols, Water quality, Biocides, Biodegradation.

The fate of pentachlorophenol (PCP), when comixed with municipal wastewater, was assessed in 3 bench-scale, continuous flow activated sludge reactors that were maintained at 5, 10, 15, and 20 day solids retention times and a hydraulic residence time of 6 hours. Reactors were taken through an increasing feed PCP concentration series. In the 10 to 20 day solids retention time systems PCP of 0.1 to 12 mg/L degraded to less than 10 micrograms/L. Removal was incomplete in the 5 day solids retention time system. PCP shock loads were administered to the 15 day solids retention time system. Effluent quality was maintained with 2-fold increases in PCP concentrations. High effluent PCP concentrations were observed one day after 5- and 10-fold increases were implemented. (Author's abstract)
W89-00509

EFFECT OF SULFATE AND ORGANIC MATTER ON THE HYDROGEN SULFIDE FORMATION IN BIOFILMS OF FILLED SANITARY SEWERS,
Aalborg Universitetscenter (Denmark). Dept. of Civil Engineering.
P. H. Nielsen, and T. Hvitved-Jacobsen.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 5, p 627-634, May 1988.

Descriptors: *Sewers, *Hydrogen sulfide, *Sulfates, *Organic matter, *Biofilm, Wastewater facilities, Pressure conduits, Chemical oxygen demand, Mathematical equations, Prediction, Domestic wastes, Substrates, Model studies, Microbiological studies, Limiting nutrients.

Sulfide formation rates were measured in a pressure main transporting mainly domestic wastewater. An empirical equation for the sulfide flux from the sewer biofilm depended on soluble chemical oxygen demand concentration in the wastewater with a power near 0.5. This empirical equation was confirmed through biofilm reactor investigations and was compared with other predictive equations. The maximum possible surface flux from the biofilm was calculated for typical values for biofilm thickness and microbial activity, all based on the data obtained. The amount and the quality of organic matter in the wastewater were important for the potential sulfide production in sewer biofilms. Furthermore, the spectrum of organics used for microbial sulfate reduction reflected the substrate on which the biofilms were grown. Sulfate was limiting for sulfate reduction only at relatively low sulfate concentrations in typical sewer biofilms. The sulfate reduction in these biofilms was modeled and was in good agreement with experimental results. The results were discussed in relation to the prediction of sulfide buildup in filled pipes. (Author's abstract)
W89-00510

INFLUENCE OF FEEDING PROCEDURE ON MICROBIAL REDUCTIONS AND PERFORMANCE OF ANAEROBIC DIGESTION,
Environmental Protection Agency, Cincinnati, OH. Water Engineering Research Lab.
J. B. Farrell, A. E. Erlap, J. Rickabaugh, D. Freedman, and S. Hayes.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 5, p 635-644, May 1988. 5 fig, 10 tab, 10 ref.

Descriptors: *Anaerobic digestion, *Microbial degradation, *Wastewater treatment, *Operating policies, Pathogens, Hydraulics, Coliforms, Viruses, Kinetics, Mathematical analysis, Retention time, Biodegradation.

The effects on microbial densities and other process parameters of changing the feeding protocol of a single stage digester from 'draw down, then fill' to 'fill, then draw down' were determined. The effects were barely noticeable for parameters like volatile solids that are reduced moderately during digestion but were large for viruses and the bacterial fecal indicators such as fecal coliform that normally are reduced in digestion by factors of 10 to 100. Equations based on first order kinetics were developed for predicting the effects of changes in hydraulic retention time and feeding protocol on microbial densities. (Author's abstract)
W89-00511

COMPRESSIBLE CAKE FILTRATION: MONITORING CAKE FORMATION AND SHRINKAGE USING SYNCHROTRON X-RAYS,
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
B. R. Bierck, S. A. Wells, and R. I. Dick.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 5, p 645-650, May 1988. 7 fig, 21 ref.

Descriptors: *Sludge cake, *Filtration, *Dewatering, *Waste treatment, *X-rays, Suspended solids, Kaolinite.

High energy, highly collimated X-rays produced at the Cornell High Energy Synchrotron Source enabled real-time suspended solids concentration measurements each second with 0.5 mm vertical separation in a kaolin filter cake. Suspended solids concentration profiles reflected expected effects of cumulative fluid drag forces. Shrinkage caused a significant increase in average cake suspended solids concentration after expiration of the slurry, and the saturated cake ultimately formed was virtually homogeneous. Shrinkage is consolidation under compressive forces created when capillary menisci form at air/liquid interfaces, and has a significant effect on cake structure in latter stages of compressible cake filtration. (Author's abstract)
W89-00512

EFFECT OF CULTURE HISTORY ON THE DETERMINATION OF BIODEGRADATION KINETICS BY BATCH AND FED-BATCH TECHNIQUES,
Engineering-Science, Inc., Atlanta, GA.
L. L. Templeton, and C. P. L. Grady.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 5, p 651-658, May 1988. 8 fig, 1 tab, 26 ref.

Descriptors: *Culturing techniques, *Kinetics, *Biodegradation, *Bacteria, *Wastewater treatment, Biological wastewater treatment, Bacterial physiology.

A pure bacterial culture was grown in continuous culture at four dilution rates with 2-chlorophenol as the carbon source. During the steady state the Monod kinetic parameters characterizing 2-chlorophenol biodegradation were determined under batch and fed-batch conditions. The values of both parameters were influenced by the dilution rate: the higher the dilution rate the larger the value of the maximum specific growth rate and the smaller the value of the half saturation coefficient. Parameter values determined under batch conditions were influenced more than those determined under fed-batch conditions. These effects were consistent with the physiological adaptation of cells to their previous growth environment. (Author's abstract)
W89-00513

EFFECTS OF DISCONTINUING DISINFECTION ON A RECEIVING WATER,
Illinois Inst. of Tech., Chicago. Dept. of Environmental Engineering.
C. N. Haas, J. G. Sheerin, C. Lue-hing, K. C. Rao, and P. O'Brien.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 5, p 667-673, May 1988. 1 fig, 6 tab, 19 ref.

Descriptors: *Fate of pollutants, *Wastewater outfall, *Impaired water quality, *Water quality, *Disinfection, *Wastewater treatment, Coliforms, Bacteria, Effluents.

The effect of discontinuing disinfection on the microbiological quality of a receiving water was examined in a 9-month field study. Receiving water quality immediately downstream of discharge decreased after discontinuation. Beyond 24 km (15 miles) from discharge, immediate adverse effects were not observed. This study supports the concept that, beyond a certain zone (and during certain times of year), chlorination of an effluent may not improve microbiological water quality. The methodology used in this study could be useful for evaluations of the microbial effects of disinfection at other locations. (Author's abstract)
W89-00515

APPLICATION OF HEADSPACE GAS CHROMATOGRAPHY TO THE MONITORING OF ORGANIC SUBSTANCES IN INDUSTRIAL EFFLUENT,
BASF A.G., Ludwigshafen am Rhein (Germany, F.R.). Aktiengesellschaft labor fuer Umweltanalytik und Okologie.
For primary bibliographic entry see Field 5A.
W89-00572

DESTRUCTION OF POLYCHLORINATED DIBENZO-P-DIOXINS AND DIBENZOFURANS IN CONTAMINATED WATER SAMPLES USING OZONE,
Institut Fresenius Chemische und Biologische Laboratorien G.m.b.H., Taunusstein-Neuhof (Germany, F.R.).
N. Palauschek, and B. Scholz.
Chemosphere CMSHAF, Vol. 16, Nos. 8/9, p 1857-1863, 1987. 2 fig, 7 tab, 5 ref.

Descriptors: *Water treatment, *Wastewater treatment, *Dioxins, *Ozonation, *Polychlorinated dibenzofurans, Chemical treatment, Organic compounds, Degradation, Oxidation, Chlorinated hydrocarbons, Hydrogen ion concentration.

Degradation of polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) in water and wastewater was studied using an ozonolysis method. The process was pH-dependent. Alkaline conditions (pH = 10) were necessary; no degradation occurred at pH 5. Increasing the temperature to 50 C accelerated the oxidation. Treatment of a series of increasingly chlorine-substituted (three to eight) compounds showed that degradation rates were faster for the compounds with fewer chlorine groups. Degradation rates were also different among the isomers of a compound. It was concluded that molecular ozone itself does not react with PCDD or PCDF; the presence of an organic solvent (e.g., 1,1,2-trichloro-trifluoroethane) is necessary. (Cassar-PTT)
W89-00606

EMISSIONS OF CHLORINATED ORGANICS FROM A MUNICIPAL SEWAGE SLUDGE BURNING INCINERATOR,
Ontario Ministry of the Environment, Rexdale. Lab. Services Branch.
For primary bibliographic entry see Field 5B.
W89-00607

TREATMENT OF DYE-CONTAINING EFFLUENTS WITH DIFFERENT BENTONITES,
Thessaloniki Univ., Salonika (Greece). Lab. of Organic Chemical Technology.
I. Arvanitoyannis, I. Eleftheriadis, and E. Kavlentis.
Chemosphere CMSHAF, Vol. 16, Nos. 10-12, p 2523-2529, 1987. 8 fig, 12 ref.

Descriptors: *Wastewater treatment, *Industrial wastes, *Dye industry wastes, *Color removal, *Bentonite, Adsorption.

Six different bentonites were used to remove color from dye-containing effluents. Two dyes of each of the basic, acid and direct types were studied. Bentonite concentrations were 0.5 to 1.0 g/liter. All bentonites were effective, nearly 100%, in removing basic dyes. Adsorption of direct dyes was 50-80%. Adsorption of acid dyes was 40-60%. Bentonites effective for basic dyes were not as effective with acid and direct dyes, and vice versa. An increase in the initial concentration of dye caused a decrease in the fraction of dye adsorbed. (Cassar-PTT)
W89-00615

REVIEW OF THE BEHAVIOUR AND UTILIZATION OF POLYCARBOXYLIC ACIDS AS DETERGENT BUILDERS,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
M. Hunter, D. M. L. da Motta Marques, J. N. Lester, and R. Perry.
Environmental Technology Letters ETLEDB, Vol. 9, No. 1, p 1-22, January 1988. 3 fig, 8 tab, 100 ref.

Descriptors: *Organic acids, *Detergents, *Wastewater treatment, *Biodegradation, Acids, Literature reviews, Degradation, Toxicity, Biological treatment, Chemical treatment, Physicochemical treatment, Polymers, Heavy metals, Public health.

The formulation of polycarboxylic acids (PCAs) into detergents as phosphate replacements or co-builders is reviewed, with particular emphasis on builder efficiency, potential wastewater treatment and environmental removal mechanisms, and the resulting implications for public health. The majority of PCAs with significant builder potential tend to rely on a carbon backbone molecular structure, and these are found to be poorly biodegradable under standard conditions. High sludge adsorption capacities for PCAs are thought to be implicated as removal mechanisms. It is estimated that 90% of PCAs occurring at a 3% level in detergents would be removed in sludge, resulting in effluent concentrations of 30 micrograms/l. The incorporation of nutrients or easily biodegradable sections within homopolymers has been suggested to enhance biodegradability. The possible effects on PCAs on heavy metal removal and distribution in

wastewater treatment and receiving waters is discussed. (Doria-PTT)
W89-00620

MICROMIXING AND DISPERSION IN CHLORINE CONTACT CHAMBERS,
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
C. N. Haas.
Environmental Technology Letters ETLEDB, Vol. 9, No. 1, p 35-44, January 1988. 2 fig, 1 tab, 17 ref.

Descriptors: *Mixing, *Wastewater treatment, *Chlorination, *Disinfection, *Kinetics, Viruses, Bacteria, Coliforms, Chemical reactions, Design criteria, Water reuse, Rational kinetic approach, Simulation.

The effects of both micro- and macromixing on chlorine inactivation in wastewater were investigated using the recently developed rational kinetic approach. Simulations were conducted in which the macromixing pattern was fixed at 100 continuous stirred tank reactors in series, and the chlorine dose and contact time were varied. Results were consistent with previous analyses. For reaction orders greater than unity, micromixing diminishes the extent of decomposition, while the inverse is true for reaction orders greater than unity. The effect of micromixing becomes particularly important at higher degrees of inactivation. It is therefore suggested that systems for reuse applications or the disinfection of poorly treated wastewaters should be designed with a safety factor to compensate for the micromixing effect. The extent of micromixing may be diminished by designing the contactor to achieve a high segregation number. (Doria-PTT)
W89-00622

EFFECT OF SULPHIDE ON THE ANAEROBIC DEGRADATION OF PROPIONATE,
Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control.
A. Rinzema, and G. Lettinga.
Environmental Technology Letters ETLEDB, Vol. 9, No. 2, p 83-88, February 1988. 3 fig, 46 ref. Dutch Government, Clean Technology Program Grant (F 41)LH511.

Descriptors: *Sulfides, *Anaerobic digestion, *Wastewater treatment, *Propionate, *Biological wastewater treatment, *Oil wastes, Biodegradation, Digestion, Industrial plants, Industrial wastes, Oil industry, Oil refineries, Bacteria, Methane bacteria, Sludge, Sulfates, Hydrogen sulfide.

The anaerobic degradation of propionate in the presence of excess sulfate was studied in an upflow anaerobic sludge bed reactor inoculated with granular sludge. A stable and efficient propionate degradation could be achieved (space load 5 kg COD/cu m/day, volatile fatty acids (VFA) removal 96%). Only 23% of the added COD was recovered as sulfide in the effluent and biogas. H2S concentrations above approximately 100 mg/l S caused a sharp drop of the VFA removal efficiency and resulted in process instability, possibly aggravated by propionate inhibition. Recovery took 3-4 weeks. Acetoclastic methanogenesis was not the rate limiting step under sulfide inhibition. (Author's abstract)
W89-00625

EFFECTS OF BIOFILTER MEDIA ON THE PERFORMANCE OF ANAEROBIC HYBRID REACTORS,
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
J. A. Oleszkiewicz, and V. J. Thadani.
Environmental Technology Letters ETLEDB, Vol. 9, No. 2, p 89-100, February 1988. 6 fig, 4 tab, 19 ref.

Descriptors: *Biofilters, *Filters, *Anaerobic digestion, *Wastewater treatment, Biodegradation, Biological wastewater treatment, Digestion, Sludge bed, Performance evaluation, Oxygen demand, Chemical oxygen demand, Tracers, Mixing, Biogas.

Four parallel anaerobic sludge bed reactors were seeded with fresh sewage sludge from an anaerobic digester and subjected to a load of sulfite evaporator condensate increasing from 1 to 20 kg COD/cu m/day. Reactors R1 and R2 had a layer of random media in the upper 40% of the volume, R3 had vertically oriented media, and R4 had no media. Hydraulic tracer analysis has shown all reactors to operate in a well mixed flow regime. In a subsequent performance comparison, reactors R3 and R4 exhibited significantly higher washout of the flocculant sludge, hydraulic shortcircuiting within the reactor, and overall poorer COD removal efficiency and gas generation than R1 and R2. (Author's abstract)
W89-00626

TREATABILITY STUDIES OF TEXTILE WASTEWATER,
National Research Centre, Cairo (Egypt). Water Pollution Control Lab.
S. I. Abo-Elela, F. A. El-Gohary, H. I. Ali, and R.Sh. A. Wahaab.
Environmental Technology Letters ETLEDB, Vol. 9, No. 2, p 101-108, February 1988. 6 fig, 3 tab, 8 ref.

Descriptors: *Wastewater treatment, *Textile mill wastes, *Chemical treatment, *Biological wastewater treatment, *Coagulation, *Activated sludge process, Industrial wastes, Chemical coagulation, Lime, Sulfates, Sludge, Activated sludge, Economic aspects, Cost analysis, Sedimentation, Effluents, Performance evaluation, Design criteria, Construction costs, Operating costs.

Coagulation-sedimentation of wastewater from a textile mill was carried on using different coagulants. The use of lime-ferrous sulfate reduced the organic load considerably. As an alternative, biological treatment of industrial wastewater combined with equal proportions of domestic sewage using a complete mixing activated sludge process produced a very high quality effluent. A final process design was developed. Economic evaluation of the methods adopted indicated that the costs of chemical treatment are far less than the costs of biological treatment. (Author's abstract)
W89-00627

REMOVAL OF CHROME DYE FROM CARPET EFFLUENTS USING COAL: I,
Banaras Hindu Univ., Varanasi (India). Dept. of Applied Chemistry.
G. S. Gupta, G. Prasad, and V. N. Singh.
Environmental Technology Letters ETLEDB, Vol. 9, No. 2, p 153-161, February 1988. 6 fig, 4 tab, 20 ref.

Descriptors: *Chromium, *Dyes, *Coal, *Adsorption, *Wastewater treatment, Heavy metals, Adsorbents, Kinetics, Effluents, Temperature, Acidity, Hydrogen ion concentration, Isotherms, Thermodynamics, Chelation, Omego chrome red ME, Carpet industry.

The ability of coal to remove Omega Chrome Red ME (a chrome dye, frequently used in carpet industries) from water was investigated. It was found that favorable factors in the removal are low adsorbate concentration, low temperature, and low pH of the medium. The kinetics of dye adsorption were determined by using Lagergren and Weber's equations. The isotherm study was done in the light of Langmuir's model. The thermodynamic study reveals that the process involved is spontaneous, exothermic, and of randomless nature. The pH effect has been explained on the basis of surface oxidation, ionization, and complexation. (Author's abstract)
W89-00630

ASSESSMENT OF THE TOXICITY OF HEAVY METALS TO THE ANAEROBIC DIGESTION OF SEWAGE SLUDGE,
National Technical Univ., Athens (Greece). Div. of Water Resources.
A. Kouzeli-Katsiri, N. Kartsonas, and A. Priftis.
Environmental Technology Letters ETLEDB, Vol. 9, No. 4, p 261-270, April 1988. 5 fig, 6 tab, 15 ref.

Descriptors: *Toxicity, *Heavy metals, *Biological wastewater treatment, *Anaerobic digestion, *Sludge digestion, Digestion, Biodegradation, Sludge, Regression analysis, Kinetics, Solids, Volatile solids, Bioassay, Biogas.

The effect of heavy metal concentration to the anaerobic sludge digestion process was studied by means of simple batch bioassay tests. Daily gas production rate and percentage volatile solid reduction decreased with increasing solids concentration. Analysis of the results by least squares showed that gas production rate was directly proportional to the concentration of metals in sludge expressed as milliequivalents per liter. Threshold values for inhibition and toxicity limits, corresponding to 20% and 50% decrease in gas production, respectively, are derived from the experimental results and can be used as a tool for diagnosis of potential toxicity. (Author's abstract)
W89-00631

APPLICATION OF BIOLOGICALLY ACTIVATED SORPTIVE COLUMNS FOR TEXTILE WASTE WATER TREATMENT,
Bialystok Technical Univ. (Poland). Inst. of Environmental Protection Engineering.
J. Paprowicz, and S. Slodczyk.
Environmental Technology Letters ETLEDB, Vol. 9, No. 4, p 271-280, April 1988. 3 fig, 5 tab, 11 ref.

Descriptors: *Sorption, *Wastewater treatment, *Biological membranes, *Textile mill wastes, *Activated carbon, Industrial wastes, Pilot plants, Coagulation, Sedimentation, Filtration, Carbon, Membranes, Microbiological studies, Bacteria, Denitrification, Oxygen demand, Chemical oxygen demand, Biodegradation.

The use of sorptive columns for mixtures of municipal and textile wastewaters was studied as the next step after physicochemical purification in a pilot plant consisting of a coagulator, settling tank, sand filter, and three sorptive columns. Wastewaters were 50% to 70% municipal and 30% to 50% textile wastes. The sorbent was activated carbon. Chemical precipitation removed 64% of pollutants. The first sorptive column removed 19% of the refractory pollutants, the second column 11%, and the third 4%. Activated carbon is a good medium for microorganisms, and studies on sorption isotherms for the first column indicated that the quantity of removed pollutants is doubled by biooxidation. Quantitative and qualitative studies of microorganisms forming a biological membrane are discussed. (Doria-PTT)
W89-00632

ADSORPTION OF INDIGO CARMINE BY ACTIVATED CARBON,
Tokushima Univ. (Japan). Dept. of Public Health.
T. Tamura, T. Miyoshi, K. Boki, and S. Tanada.
Environmental Technology Letters ETLEDB, Vol. 9, No. 4, p 281-286, April 1988. 5 fig, 2 tab, 12 ref.

Descriptors: *Indigo carmine, *Dyes, *Activated carbon, *Wastewater treatment, *Adsorption, Carbon, Pore size, Hydrogen ion concentration, Isotherms, Alkalinity, Chemical properties, Equilibrium.

Adsorption of indigo carmine as an acid dye onto activated carbon was studied to elucidate its behavior on the basis of amount adsorbed, pore size distribution, pH and basicity of activated carbon, and pH of filtrate. Activated carbon No. 1 and No. 4 were the preferred adsorbents for removing indigo carmine in the range of higher equilibrium concentration of about 200 ppm and the lower equilibrium concentration of 1 ppm or less, respectively. The adsorption isotherms of indigo carmine on activated carbon are well expressed by the Freundlich equation. No correlation was found between the amount adsorbed and pH or basicity of activated carbon. An approximately linear relation was found between the amount adsorbed and

the volume of pores with a radius of < 200 A. (Author's abstract)
W89-00633

HIGH LEVEL DISINFECTION OF WASTEWATERS FOR REUSE,
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Dept. of Civil Engineering.
S. Farooq, and A. Bari.
Environmental Technology Letters ETLEDB, Vol. 9, No. 5, p 379-390, May 1988. 8 fig, 1 tab, 18 ref. Saudi Arabian National Center for Science and Technology Research Grant SANCST AR-3-018.

Descriptors: *Disinfection, *Water reuse, *Wastewater treatment, *Ozonation, Potassium ferrates, Coliforms, Pilot plants, Iron, Heavy metals, Ozone.

Ferrate and ozone were investigated in a bench-scale pilot treatment system for disinfection of three different wastewaters with an objective of achieving 70 to 2.2 MPN of total coliforms/100 ml. These high levels of disinfection are recommended for growing fish and food crops, for restricted recreational waters, and for direct reuse. In secondary effluent, the total coliforms can be reduced to 2.2 MPN/100 ml with a potassium ferrate dose of 15 mg/l and ozone consumption of 1 to 5.28 mg/l, while in lime-treated sewage and settled sewage the best levels of disinfection are 170 MPN and 551 MPN/100 ml, in spite of increased ozone utilization of 36.6 and 41.3 mg/l, respectively. (Author's abstract)
W89-00642

COMPARISON OF CO-DIGESTION PERFORMANCE OF TWO DIFFERENTLY COLLECTED ORGANIC FRACTIONS OF MUNICIPAL SOLID WASTE WITH SEWAGE SLUDGES,
Venice Univ. (Italy). Dept. of Environmental Science.
F. Cecchi, P. G. Traverso, G. Perin, and G. Vallini.
Environmental Technology Letters ETLEDB, Vol. 9, No. 5, p 391-400, May 1988. 7 fig, 3 tab, 17 ref.

Descriptors: *Anaerobic digestion, *Municipal wastes, *Solid wastes, *Sludge, *Sludge digestion, *Biological wastewater treatment, Performance evaluation, Biodegradation, Digestion, Pilot plants, Italy, Carbon, Nitrogen, Wastewater treatment.

The co-digestion performances of two pilot plant digesters in Italy treating organic fractions of municipal solid waste and primary and secondary sewage sludges mixed at various ratios between 0% and 100% were compared. Differences in collection procedures influence the chemical characteristics of the substrates and thus process performance. It was concluded that (1) the addition of the organic fraction of municipal solid waste to the sewage sludge substantially increases reactor performance; (2) the quality of the organic feed, particularly the solute carbon portion, is responsible for the differences in performance; (3) the C/N ratios of the substrates did not influence performance; (4) fine sand in sewage sludges increases the ratio of microorganisms to total volatile solids inside the reactor; and (5) for both co-digestion processes, the optimum value for hydraulic retention time (solids retention time) is 14-15 days. (Author's abstract)
W89-00643

VIABILITY DETERMINATION OF ASCARIS EGGS RECOVERED FROM WASTE-WATER,
Nancy-1 Univ. (France). Faculte de Pharmacie.
For primary bibliographic entry see Field 5A.
W89-00644

LIQUID EFFLUENTS OF THE FISH CANNING INDUSTRIES OF RIO DE JANEIRO STATE: TREATMENT ALTERNATIVES,
Universidade Federal do Rio de Janeiro (Brazil). Coordenacao dos Programas de Pos-graduacao de Engenharia.
A. L. C. Aguiar, and G. L. Sant'Anna.
Environmental Technology Letters ETLEDB, Vol. 9, No. 5, p 421-428, May 1988. 7 fig, 4 tab, 10 ref.

Descriptors: *Wastewater treatment, *Canneries, *Food-processing wastes, *Chemical treatment, *Biological wastewater treatment, Industrial plants, Industrial wastes, Wastes, Rio de Janeiro, Sedimentation, Coagulation, Chemical coagulation, Flocculation, Digestion, Aerobic digestion, Anaerobic digestion, Activated sludge process, Biodegradation, Effluents, Oxygen demand, Chemical oxygen demand, Oil, Grease, Brazil, Aluminum sulfate.

The pollution problems associated with liquid effluents of the fish-canning industries in Rio de Janeiro State, Brazil are evaluated, and the results of bench-scale treatment processes are presented. The alternative proposed is a sequential treatment combining physicochemical and biological processes. Removals of 32% COD, 67% oil and grease, and 50% suspended solids were observed in the simple sedimentation stage. For the coagulation/flocculation step, aluminum sulfate can be applied in a range of 75-300 mg/l at pH 5.0-5.5. Removals attained in this second stage were 31% COD, 86% oil and grease, and 70% suspended solids. The biological system tested seemed adequate for these industries, and can be installed as an underground channel for effluent draining. It needs minimum operation control and occupies available land. The average COD removals observed in the aerobic reactor were 47% and 64% for hydraulic retention times of 10 and 30 hours, respectively. The accumulated removals attained in the first and second treatment stages were 52% COD, 96% oil and grease, and 84% suspended solids. An additional degradation of soluble organics was observed in the biological reactor, elevating COD removal to 78%. An optimization of the treatment stages would enhance the COD removal. (Author's abstract)
W89-00646

ISOLATION, IDENTIFICATION AND CHARACTERISATION OF FILAMENTOUS AND FLOC-FORMING BACTERIA FROM ACTIVATED SLUDGE FLOCS,
Leeds Univ. (England). Dept. of Civil Engineering.
N. J. Horan, A. M. Bu'Ali, and C. R. Eccles.
Environmental Technology Letters ETLEDB, Vol. 9, No. 5, p 449-457, May 1988. 5 tab, 27 ref. SERC Grant No. R/D/26368.

Descriptors: *Bacteria, *Bacterial analysis, *Activated sludge, *Wastewater composition, *Exopolysaccharide, *Flocculation, Wastewater treatment, Sludge, Bacterial physiology, Chromatography, Thin layer chromatography, Culture media, Carbohydrates, Chemical analysis, Photometry, Spectrophotometry, Activated sludge process, Limiting nutrients, Nitrogen, Phosphorus, Carbon.

A total of 12 different bacterial species capable of producing exopolysaccharide in liquid media, and three species exhibiting filamentous growth, were isolated from activated sludge flocs. Exopolysaccharide producers were isolated only in media for which nitrogen or phosphorus was growth limiting, and not from carbon-limited medium. The main biochemical characteristics of both the floc-forming and filamentous bacteria were determined and exopolysaccharide from isolates was purified and characterized. Isolates from nitrogen-limited media appeared the most probable contributors to exopolysaccharides found in activated sludge flocs. (Author's abstract)
W89-00648

COST EFFICIENCY OF TRANSFERABLE DISCHARGE PERMIT MARKETS FOR CONTROL OF MULTIPLE POLLUTANTS,
Illinois Univ., Urbana. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W89-00697

OPERATION OF A THREE-PHASE BIOFILM FLUIDIZED SAND BED REACTOR FOR AEROBIC WASTEWATER TREATMENT,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Dept. of Chemical Engineering.
G. Ryhiner, S. Petrozzi, and I. J. Dunn.
Biotechnology and Bioengineering BIBIAU, Vol. 32, No. 5, p 677-688, August 1988. 18 fig, 4 tab, 7 ref.

Descriptors: *Wastewater treatment, *Biological treatment, *Aerobic treatment, *Fluidized bed process, Three-phase biofilm fluidized sand-bed reactors, Glucose, Yeasts, Hydrolysis, Substrates, Aeration, Organic carbon, Oxygen uptake.

A biofilm fluidized sand-bed column reactor (14 L) was operated in the three-phase mode on a soluble glucose/yeast-hydrolysate substrate in which the biofilm/sand phase (1-2.5 L) was suspended by direct aeration of the bed. Within two weeks a tight biofilm was formed whose activity resulted in a 90% reduction, with loads of 10.7 kg total organic carbon/cu m/day. The residence time was 1 h. The biofilm remained intact during operation with high residence times (up to 23 h) over three weeks. Oxygen-transfer coefficients varied with aeration rate and sand quantity between 0.02 and 0.04/s during nongrowth conditions; they decreased with increasing amounts of clean sand and were higher and relatively independent of the sand fraction with biofilm-covered sand. Aeration rates used in the 14 L reactor were 23-40 L/min (2.4-4.1 cm/s) and were sufficient to suspend 78-92% of the biofilm-covered sand. Clean sand was 50-75% suspended. Oxygen-uptake rates varied between 15.4 and 23.1 mol/cu m/h. (Author's abstract)
W89-00747

PLANNING INDIANA'S WATER INFRASTRUCTURE FROM A COMPETITIVE PERSPECTIVE,
Purdue Univ., Lafayette, IN. School of Civil Engineering.
For primary bibliographic entry see Field 6B.
W89-00880

CHARACTERIZATION OF THE INTERACTION BETWEEN VIRUSES AND A SOLID POLYMERIC CONTACT DISINFECTANT,
Arizona Univ., Tucson. Dept. of Microbiology and Immunology.
For primary bibliographic entry see Field 5F.
W89-00884

SPECIATION STUDIES OF COPPER AND MAGNESIUM IN DUCKWEED EXTRACT USING INTERFACED HPLC AND THERMOSPRAY NEUBULIZER FLAME AA,
Louisiana State Univ., Baton Rouge. Dept. of Chemistry.
S. C. Mo, D. S. Choi, and J. W. Robinson.
Journal of Environmental Science and Health (A) JESEDU, Vol. 23, No. 5, p 441-451, 1988. 5 fig, 4 tab, 21 ref.

Descriptors: *Data aquisition, *Magnesium, *Measuring instruments, *Liquid chromatography, *Atomic absorption spectroscopy, *Duckweed, *Copper, Laboratory equipment, Chlorophyll, Pigments, Chemical analysis.

Studies on duckweed extract indicated that at least some of the magnesium in chlorophyll was replaced by copper. The copper combined not only with chlorophyll, but also with some other plant pigments in duckweed. The study also demonstrated that high-performance liquid chromatography/atomic absorption (HPLC-AA) can be used to study the speciation of the copper and magnesium in duckweed, revealing the total number of such compounds present and the associated organic compounds. HPLC-AA has the potential of extensive speciation application in many fields of science. To obtain the information needed, the electronic spectra and HPLC-AA chromatograms of three samples of treated duckweed were recorded. The three samples were: (i) a sample of solution extracted with ethanol from duckweed (DW-ex-

tract); (ii) the product of reaction between DW-extract and copper aqueous solution; (iii) the extract of duckweed which has been pretested with copper aqueous solution at pH 5.0. (Author's abstract)
W89-00886

BULKING CONTROL WITH OZONATION IN A NUTRIENT REMOVAL ACTIVATED SLUDGE SYSTEM,
Pretoria Univ. (South Africa). Dept. of Chemical Engineering.
J. van Leeuwen.
Water SA, Vol. 14, No. 3, p 119-124, July 1988. 6 fig, 4 tab, 26 ref.

Descriptors: *Activated sludge process, *Wastewater treatment, *Bulking sludge, *Ozonation, Nutrient removal, Suspended solids, South Africa, Phosphates, Color, Settelable solids.

The control of sludge bulking by ozonation was studied on four parallel pilot-scale (110 l/d) biological nutrient removal systems. Bulking was caused by filamentous organisms which typically occur in nutrient removal systems such as: (1) Type 0092, (2) Type 0041, and (3) Microthrix parvicella. Continuous dosing of ozone at 1, 2 and 4 g O3/kg mixed liquor suspended solids/day resulted in a diluted sludge volume index of about 50 ml/g less than the unozonated control. Ozonation was more effective in the sludge cycle than directly into the aeration basin. Nitrification-denitrification was not affected, not even at dosages of 30 g O3/kg mixed liquor suspended solids/day. Biological phosphate removal was not affected by any of the ozone dosages either. The removal of chemical oxygen demand was improved, as was color and suspended solids. It is concluded that ozone is an effective deterrent against the filamentous growths causing poor settleability in activated sludge. (Author's abstract)
W89-00930

SEWAGE PURIFICATION IN SOUTH AFRICA - PAST AND PRESENT,
Johannesburg City Health Dept. Labs. (South Africa).
D. W. Osborn.
Water SA, Vol. 14, No. 3, p 139-151, July 1988. 9 fig, 110 ref.

Descriptors: *South Africa, *History, *Wastewater treatment, *Biological treatment, Effluents, Ocean dumping, Screens, Chemical treatment, Sedimentation, Filtration, Activated sludge process.

Progress in the treatment of waste water in South Africa from the 1890's to the middle 1980's is presented historically to approximately 1919. Thereafter, consideration is given to environmental aspects and developments taking place in various unit processes, including: (1) detritus removal, (2) screening, (3) sedimentation, (4) sludge treatment and disposal, (5) biological filters, (6) the activated sludge process, (7) algal systems, (8) effluent polishing techniques, (9) chemical treatment, and (10) marine disposal. (Author's abstract)
W89-00933

COPPER, NICKEL, AND CHROME RECOVERY IN A JOBSHOP TO ELIMINATE WASTE TREATMENT AND SLUDGE DISPOSAL,
Eco-Tec Ltd., Pickering (Ontario).
M. Dejak, and T. Nadeau.
Hazardous Waste and Hazardous Materials HWHME2, Vol. 4, No. 3, p 261-271, Summer 1987. 4 fig, 9 tab, 1 ref.

Descriptors: *Metal-finishing wastes, *Sludge disposal, *Wastewater treatment, *Waste recovery, *Copper, *Nickel, *Chromium, *Ion exchange, *Economic aspects, *Financial feasibility, Contact beds, Industrial waste.

A metal finishing plant carrying out copper, nickel and chrome plating decided to install chemical recovery systems instead of conventional destruction/precipitation waste treatment that would represent an ongoing cost without payback. Recovery systems, employing a unique short bed ion exchange technology, were selected to operate on rinses following each of the plating rinses. The greatest savings have been realized by the chromic acid recovery system. The greater benefits and higher utilization of the chrome system compared with the other systems was due to the fact that hard chrome plating production, not requiring nickel or copper plating, is carried out as well as decorative chrome plating. Nickel sulfate recovery savings were moderate and can increase significantly as production increases. Low copper plating production resulted in minimal savings. Based on the level of copper plating production, a recovery system could not be justified. (Friedmann-PTT)
W89-00993

FORMATION OF HYDROUS ZIRCONIUM (IV) OXIDE POLYELECTROLYTE MEMBRANES, I. POLY (ITACONIC ACID) AND POLY (ACRYLIC-CO-ITACONIC ACID),
Stellenbosch Univ. (South Africa). Inst. for Polymer Science.
For primary bibliographic entry see Field 3A.
W89-01062

RO DESALINATION IN NORTHWEST CHINA,
Lanzhou Inst. of Membrane Science and Tech. (China).
For primary bibliographic entry see Field 3A.
W89-01065

PRELIMINARY PLAN FOR MEMBRANE DESALINATION IN CHINA,
National Bureau of Oceanography, Hangzhau (China). Second Inst. of Oceanography.
For primary bibliographic entry see Field 3A.
W89-01066

SELECTING A CONTRACT OPERATOR FOR YOUR WATER OR WASTEWATER FACILITY,
Professional Services Group, Inc., Houston, TX.
For primary bibliographic entry see Field 5F.
W89-01100

FINE BUBBLE AERATION: CONSIDERATIONS IN DESIGN AND OPERATION,
M. Schoenenberger.
Water/Engineering and Management WENMD2, Vol. 135, No. 8, p 30-34, August 1988. 2 tab, 2 ref.

Descriptors: *Wastewater treatment, *Aeration, Design criteria, Bubble diffusers, Oxygen transfer, Maintenance, Performance evaluation, Temperature, Pressure, Gases, Fouling.

Fine bubble diffusers for aeration in wastewater treatment can be divided into two groups: membrane diffusers and rigid diffusers (fused aluminum oxide). Oxygen transfer efficiency of the diffusers is adversely affected by greater distance between headers, lower density of diffusers, higher air rate per diffuser, lesser submergence, low alpha, higher temperatures, lower ambient air pressures, higher dissolved oxygen concentrations, and greater dissolved solids concentrations. Fine bubble diffusers have a tendency to become fouled, increasing pressure demand and reducing the oxygen transfer efficiency. Fouling is aggravated by low dissolved oxygen concentrations, high alkalinity or hardness, adherent industrial pollutants, high suspended solids concentrations, and high nutrient concentrations. Diffusers may be cleaned by high-pressure hosing, brushing, high temperature baking, acid bath or spray, and/or in situ acid injection. Circular, square, or step-feed reactors will normally produce complete mix conditions, whereas long and narrow tanks or reactors in series will produce plug flow conditions. Design criteria are given for a fine bubble diffuser system, as well as criteria for evaluating equipment proposals. (Cassar-PTT)
W89-01101

MAKING THE RIGHT MOVES IN SCADA SELECTION,
HSQ Technology, Inc., San Francisco, CA.
For primary bibliographic entry see Field 5F.
W89-01103

DISPOSAL OF RADIUM REMOVED FROM DRINKING WATER,
Wisconsin Dept. of Natural Resources, Madison.
For primary bibliographic entry see Field 5E.
W89-01106

MICROBIAL CHARACTERIZATION OF MUNICIPAL WASTEWATER AT A SPRAY IRRIGATION SITE: THE LUBBOCK INFECTION SURVEILLANCE STUDY,
Texas Univ. at Austin. Dept. of Microbiology.
For primary bibliographic entry see Field 7B.
W89-01124

PHOSPHORUS REMOVAL BY CRYSTALLIZATION USING A GRANULAR ACTIVATED MAGNESIA CLINKER,
Hitachi Research Lab. (Japan).
S. Kaneko, and K. Nakajima.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 7, p 1239-1244, July 1988. 10 fig, 1 tab, 18 ref.

Descriptors: *Phosphorus removal, *Crystallization, *Alkalinity, *Wastewater treatment, Magnesia clinker, Hydroxy apatite, Secondary wastewater.

Phosphorus was removed from synthetic solutions and secondary effluents by a crystallization process involving seeded, supersaturated hydroxy apatite solutions. Phosphorus removal efficiencies using various seed crystals were evaluated in laboratory-scale studies. The activated magnesia clinker was not affected by the bicarbonate alkalinity of the wastewater treatment secondary effluents and showed the highest phosphorus removal efficiency. Pilot-scale studies operated on the site of a sewage treatment plant for about 2.5 years. Analysis of the pilot-scale studies data showed that the influence of the bicarbonate alkalinity of secondary effluents is very small. Therefore, a conventional decarbonation process can be omitted. (Author's abstract)
W89-01126

IN SITU ADAPATION OF ACTIVATED SLUDGE BY SHOCK LOADING TO ENHANCE TREATMENT OF HIGH AMMONIA CONTENT PETROCHEMICAL WASTEWATER,
Rhode Island Univ., Kingston. Dept. of Civil and Environmental Engineering.
L. T. Thiem, and E. A. Alkhatib.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 7, p 1245-1252, July 1988. 13 fig, 6 tab, 15 ref.

Descriptors: *Activated sludge process, *Wastewater treatment, *Industrial wastes, *Chemical wastewater, Nitrification, Shock loads, Biochemical oxygen demand, Ammonia, Chemical oxygen demand, Pilot plants, Sulfides.

A modified activated sludge process that includes both carbonaceous and nitrogenous oxidation to reduce high levels of ammonia in petrochemical wastewater was studied in a pilot plant design. Dissolved oxygen, pH, temperature and sludge age were controlled and measured. Ammonia concentration in the petrochemical wastewater used as the influent waste to the pilot plant was maintained up to 390 mg/L. Adaptation of the activated sludge biomass to the influent was accomplished with step-function shock loading. Subsequently, operation in the zero sludge wasting mode resulted in a low excess sludge production rate and the minimization of nitrifier washout and high percentage removals of ammonia, chemical oxygen demand, biochemical oxygen demand, and sulfide were measured. (Author's abstract)
W89-01127

USE OF DUCKWEED FOR WASTEWATER TREATMENT,
ERM-Southeast, Inc., Atlanta, GA.

J. Zirschky, and S. C. Reed.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 7, p 1253-1258, July 1988. 4 fig, 2 tab, 19 ref.

Descriptors: *Wastewater treatment, *Lagoons, *Algae, *Nutrients, *Duckweed, Design criteria, Wastewater lagoons, Wetlands, Nutrients removal.

The operation of six duckweed treatment systems is briefly reviewed. Significant design considerations include: (1) a 20-day detention time for algae removal in wastewater lagoons, (2) a 10-day detention time for algae removal in a constructed wetland, and (3) additional cells for systems that do not adequately remove soluble biochemical oxygen demand. Provisions are recommended for algae removal for post aeration and in case the duckweed dies from disease. To ensure algae removal, it is essential to maintain a complete surface cover of duckweed continuously. Baffles or other containment devices are necessary to hold the duckweed in place on large open ponds. (Miller-PTT)
W89-01128

EVALUATION OF CHEMICAL OXIDIZERS FOR HYDROGEN SULFIDE CONTROL,
New Mexico State Univ., Las Cruces. Dept. of Civil Engineering.
F. Cadena, and R. W. Peters.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 7, p 1259-1263, July 1988. 4 fig, 3 tab, 12 ref.

Descriptors: *Wastewater, *Hydrogen sulfide, *Corrosion control, *Oxidation, *Sewers, *Odor control, *Kinetics, Sulfides.

Theoretical hydrogen sulfide oxidation reactions reviewed as part of a study to evaluate sulfide corrosion inhibitors in sewer systems. Stoichiometric requirements were determined for typical wastewater samples. The oxidation of 1 gram of sulfide in the laboratory conditions required 2.4, 4.2 and 11.8 grams of hydrogen peroxide, chlorine and potassium permanganate, respectively. First-order kinetics with linear sulfide generation describe the hydrogen sulfide oxidation with hydrogen peroxide. The kinetic constants for sulfide oxidation and in vitro generation are 0.120 per min and 0.38 mg per L-h. Chlorine compound and potassium permanganate oxidation reactions are complete in less than 5 minutes contact time. (Author's abstract)
W89-01129

KINETICS OF SULFIDE OXIDATION BY DISSOLVED OXYGEN,
Water Authority of Western Australia, Perth.
P. D. Wilmot, K. Cadee, J. J. Katinic, and B. V. Kavanagh.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 7, p 1264-1270, July 1988. 3 fig, 7 tab, 7 ref.

Descriptors: *Oxidation, *Kinetics, *Sulfide, *Wastewater treatment, *Dissolved oxygen, *Temperature effects.

The kinetics of sulfide oxidation by dissolved oxygen in three domestic wastewaters containing concentrations between 0.2 and 8 mg/L sulfide and 5 and 20 mg/L oxygen were studies. The reaction order with respect to sulfide varied with sulfide concentration but was approximately first order for two of the wastewaters and significantly less for the third. The reaction order with respect to oxygen could be described by Michaelis-Menton kinetics, with K = 3 mg/L. Chemical and biological components of the oxidation process were significant over the concentration range studied. The effect of temperature on the rate constant was well described by the Arrhenius equation. Rate constant data for 14 wastewater samples are presented. Variability in this data indicate that in designing an oxygen injection facility it would be desirable to characterize the sulfide oxidation kinetics of the wastewater under study by conducting a series of initial rates trials. (Miller-PTT)
W89-01130

NEW MEASURE OF INTERDEPENDENCE AMONG SEVERAL POLLUTANTS,
Illinois Univ. at Urbana-Champaign. Dept. of Veterinary Biosciences.
D. L. Schaeffer.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 7, p 1271-1274, July 1988. 5 tab, 7 ref.

Descriptors: *Wastewater treatment, *Design criteria, *Biochemical oxygen demand, *Suspended solids, Flow, Multivariate analysis, Statistical analysis.

A correlation measure, which tests interdependence among more than two features for observations expressible as binary (0 or 1) values, is illustrated using data from a domestic sewage treatment plant. Pairwise correlations were determined for violations of influent biochemical oxygen demand, suspended solids, and average flow design limits. Violations of biochemical oxygen demand and suspended solids were positively correlated with each other and negatively correlated with flow violations. Similar results were obtained for effluent violations. Three-way correlations for both influent and effluent were significant and negative, suggesting that flow was a common causative factor for the noncompliance events in this plant. (Author's abstract)
W89-01131

REMOVAL OF ORGANIC TOXIC POLLUTANTS BY TRICKLING FILTER AND ACTIVATED SLUDGE,
S. A. Hannah, B. M. Austern, A. E. Eralp, and R. A. Dobbs.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 7, p 1281-1283, July 1988. 5 tab, 1 ref.

Descriptors: *Wastewater treatment, *Activated sludge process, *Trickling filters, *Toxic waste treatment, *Nitrification, *Municipal wastewater, Pollutants, Suspended solids, Chemical oxygen demand, Priority pollutants, Organic compounds.

The ability of wastewater treatment processes (trickling filter and activated sludge) to remove toxic organics is discussed as part of a long-term research program conducted by the EPA. Municipal wastewater influent to the two systems was spiked with 21 priority pollutant organics dissolved in toluene to provide nominal concentration of 100 micrograms/liter of each priority pollutant. Average removal of total suspended solids by the activated sludge system was 87% while removal of chemical oxygen demand was 72%. Nitrification, which occurred throughout the study, reduced total Kjeldahl nitrogen by 77%. Reductions of the total suspended solids, chemical oxygen demand and total kjeldahl nitrogen for the trickling filter were 92, 69, and 34%, respectively. Overall removal of volatiles by both systems, calculated by averaging removals of individual organics, exceeded 91%. Removability data from the activated sludge control systems used in this study provide some perspective on the reproducibility of removal data from the same municipal wastewater source at different times. The results indicate that, at any given location, toxics removal data from municipal wastewater will vary despite the best efforts to hold experimental conditions at a steady state. (Miller-PTT)
W89-01133

QUALITY CONTROL APPROACH TO NPDES COMPLIANCE DETERMINATION,
Construction Engineering Research Lab. (Army), Champaign, IL.
D. J. Schaeffer, and H. W. Kerser.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 8, p 1436-1438, August 1988. 2 tab, 6 ref.

Descriptors: *Monitoring, *Statistical analysis, *Wastewater treatment, *Effluents, *Quality control, Water quality control, Water quality standards.

A test criterion was developed to estimate the fraction of noncompliance months in an effluent compliance monitoring program. Typical permit effluent limits for a pollutant are specified as a maximum monthly average and a daily sample maximum. Values reported to the regulatory agency by the permitee usually are limited to monthly minima, maxima, averages and numbers of observations. The regulator uses an arbitrary multiple of a permit limit to judge whether the monthly average for a pollutant is in compliance. Viewing the problem of noncompliance from the perspective of statistical quality assurance, noncompliance with a monthly average value occurs when the fraction of defective (out of compliance) analyses in a month is too high. (Author's abstract)
W89-01136

SEQUENTIAL WET AIR REGENERATION OF PAC FROM THE POWDERED CARBON-ACTIVATED SLUDGE PROCESS,
Illinois Univ., Urbana. Dept. of Civil Engineering.
M. A. Recktenwalt, V. L. Snoeyink, and R. A. Larson.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 8, p 1439-1444, August 1988. 7 fig, 1 tab, 13 ref. EPA Cooperative Agreement CR812582-01.

Descriptors: *Activated carbon, *Sludge treatment, *Regeneration, *Wastewater treatment, Wet air regeneration, Adsorption, Organic carbon, Industrial wastewater.

The effects of successive regeneration of powdered activated carbon were studied under controlled conditions that simulated full-scale operation of wet air regeneration in the powdered carbon activated sludge process. These experiments demonstrated that successive regenerations resulted in a progressive decrease in adsorption capacity for 2,4-dinitrophenol. This loss in adsorption capacity was due to a combination of an increase in surface oxides and residual compounds remaining on the powdered activated carbon after regeneration. The adsorption capacity of total organic carbon in secondary effluent, however, decreased only slightly through successive regenerations once the residual compounds on the powdered activated carbon were removed by extraction. (Author's abstract)
W89-01137

BIOSORPTION OF ORGANIC HALIDE IN A KRAFT MILL GENERATED LAGOON,
Arizona Univ., Tucson. Dept. of Civil Engineering.
G. L. Amy, C. W. Bryant, B. C. Alleman, and W. A. Barkley.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 8, p 1445-1453, August 1988. 9 fig, 5 tab, 25 ref.

Descriptors: *Industrial wastewater, *Lagoons, *Bleaching wastes, *Pulp wastes, *Organic compounds, *Halides, *Wastewater treatment, Biosorption, Adsorption, Pulp and paper industry, Biological wastewater treatment.

The role of biosorption on the removal of organic halide by an aerated lagoon was examined. Both adsorption experiments and a limited number of desorption experiments were conducted. Controlled variables within the experimental design of the adsorption experiments included cell age, cell viability, pH, temperature, biomass concentration and contact time. pH was the only controlled variable in the desorption experiments. The sorbent was virgin biomass derived from either the recycle line of a conventional activated sludge system, or a series of bench-scale reactors. Both variable (live) and inactivated (dead) biomass were studied. Kraft mill wastewater contains substantial concentrations of both total organic halide and low molecular weight (less than 1000 g) total organic halide as a consequence of chlorine bleaching activities. An aerated lagoon removes from one-third to one-half of both these fractions of organic halide. Indirect evidence suggests that anaerobic degradation and dehalogenation occur in the benthal layer of the lagoon. Sorption onto settling biomass is the mechanism required for transport to the benthal layer. Aerobic biomass is capable of

adsorbing both high and low molecular weight total organic halide. Adsorption is affected by pH, temperature, cell age and cell viability. (Miller-PTT)
W89-01138

MCRT FOR CONTROL OF COKEMAKING WASTEWATER TREATMENT,
Southern Illinois Univ. at Edwardsville. Environmental Resources Training Center.
H. H. Bengston, and C. E. Cannon.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 8, p 1454-1456, August 1988. 4 fig, 1 tab, 7 ref.

Descriptors: *Coke wastes, *Wastewater treatment, *Activated sludge process, *Industrial wastewater, Coke, Mean cellular residence time, Monitoring, Aeration.

Monitoring of an extended aeration/activated sludge treatment process for cokemaking wastewater showed that mean cell residence time (MCRT) was more suitable as a control parameter than food:microorganism ratio, particularly for minimizing effluent suspended solids discharge. The study is based on operating data from the first 11 months of plant operation. Analysis of the operating data showed effluent suspended solids discharge to correlate with mean cell residence time much better than with food:microorganism ratio. As a result, the treatment plant is now operated with mean cell residence time as the control parameter. (Author's abstract)
W89-01139

COMPARISON OF CHEMICAL BIODEGRADATION RATES IN BOD DILUTION AND NATURAL WATERS,
Wisconsin Univ.-Superior. Center for Lake Superior Environmental Studies.
For primary bibliographic entry see Field 5B.
W89-01158

STUDIES ON THE DEGRADATION OF SYNTHETIC DETERGENTS BY SEWAGE,
National Research Centre, Cairo (Egypt).
For primary bibliographic entry see Field 5B.
W89-01159

SEPTIC SYSTEM PERFORMANCE ON A COASTAL BARRIER ISLAND,
Washington State Univ., Puyallup. Western Washington Research and Extension Center.
C. G. Cogger, L. M. Hajjar, C. L. Moe, and M. D. Sobsey.
Journal of Environmental Quality JEVQAA, Vol. 17, No. 3, p 401-408, July-September 1988. 5 fig, 6 tab, 18 ref. NOAA Grant R/CZS-17.

Descriptors: *Wastewater disposal, *Septic tanks, *Barrier islands, *Water pollution sources, *Wastewater treatment, *Groundwater pollution, Performance evaluation, Soil types, Water table, Experimental design, Nitrogen, Phosphorus, Ions, Coliforms, Oxidation-reduction potential, Anaerobic conditions, Aerobic conditions, Nitrification, Water table fluctuations.

A field experiment was conducted on a Corolla fine sand (Aquic Quartzipsamment) to evaluate wastewater treatment by septic systems under conditions typical of Atlantic coastal barrier islands. The effects of loading rate and water-table depth on wastewater treatment were studied. Two absorption fields were installed and were designated the upper and lower fields; the trenches in the lower field were 30 cm closer to the water table than those in the upper field. Each field consisted of nine absorption trenches. Three loading rates (1, 4, and 16 cm/d) were each replicated three times in a completely randomized design. Groundwater samples collected biweekly from shallow wells (1.5-1.9 m deep) between May 1982 and December 1983 were analyzed for nitrate nitrogen; ammonia nitrogen; soluble phosphorus; ionic sodium, chloride, and potassium; and fecal coliform bacteria. During the first year, the water table was within 30 cm of the lower field trenches 20% of the time and anaerobic conditions prevailed. Groundwater samples collected adjacent to the trenches contained predominantly ammonia nitrogen, fecal coliform counts averaged over 25,000 MPN (most probable number)/L, and the redox potential averaged <300 mV. During the second autumn the lower field showed aerobic tendencies due to drier weather and a deeper water table. The upper field remained aerobic throughout, with almost complete nitrification occurring. Average fecal coliform counts were reduced to 60 MPN/L, and the mean redox potential was >500 mV. The wastewater loading rate had a significant effect on the levels of all constituents, but the loading rate effect was smaller than the water table effect. Phosphorus movement appeared to be related to pore-water velocity. (Author's abstract)
W89-01163

SHALLOWLY PLACED, LOW PRESSURE DISTRIBUTION SYSTEM TO TREAT DOMESTIC WASTEWATER IN SOILS WITH FLUCTUATING HIGH WATER TABLES,
Law Environmental, Inc., Kennesaw, GA.
L. W. Stewart, and R. B. Reneau.
Journal of Environmental Quality JEVQAA, Vol. 17, No. 3, p 499-504, July-September 1988. 4 fig, 3 tab, 20 ref.

Descriptors: *Wastewater disposal, *Domestic wastes, *Water pollution sources, *Soil water table, *Water table fluctuations, Coastal plains, Performance evaluation, Soil types, Aeration zone, Soil horizons, Effluents, Bacteria, Coliforms, Phosphorus, Nitrates, Denitrification, Chlorides.

Soils with seasonally-fluctuating high water tables are common in the Atlantic Coastal Plain and are considered to be unsuited for conventional on-site wastewater-disposal systems (OSWDSs). A study was conducted to monitor the performance of a shallowly-placed, low-pressure OSWDS in a Typic Ochraqualt. Low-pressure distribution and shallow placement were used to achieve uniform distribution and maintain an unsaturated zone in the more biologically-active upper soil horizons. This combination was used to reduce movement of bacteria and phosphorus while utilizing water-table fluctuations to enhance denitrification. Changes in water-table levels, effluent distribution, and movement of fecal coliforms and selected chemical contaminants in groundwaters were monitored in situ from December 1980 through May 1982. An unsaturated zone was present beneath the OSWDS during the entire study except for the period from January through May of 1982. During this period the water table intersected the OSWDS, for some time interval (<24 h), on 36 d primarily following large rainfall events. Movement of fecal coliforms and P were restricted both horizontally and vertically. Nitrate concentrations were highest beneath the OSWDS during periods of rising water tables following prolonged periods of time when the water table was deeper than 1.5 m. Following the accumulation of nitrate-nitrogen in the upper portion of the water table, nitrate-N concentrations decreased rapidly. The observed decrease in nitrate-N was attributed to denitrification and was supported by nitrate-N/chloride ratios. Based on nitrate-N/chloride ratios, approximately 90% of the nitrate-N could not be accounted for with increased distance from the OSWDS. (Author's abstract)
W89-01171

KINETICS AND REACTION ENGINEERING OF ANAEROBIC SEWAGE TREATMENT (KINETIK UND REAKTIONSTECHNIK DER ANAEROBEN ABWASSERREINIGUNG),
Technische Univ. Berlin (Germany, F.R.). Inst. fuer Chemieingenieurtechnik.
U. Wiesmann.
Chemiengenieurtechnik CITEAH, Vol. 60, No. 6, p 464-474, June 1988. 10 fig, 4 tab, 43 ref. English summary.

Descriptors: *Kinetics, *Wastewater treatment, *Methane bacteria, *Anaerobic digestion, Acetic acid, Bacteria, Biofilms, Process control, Chemical reactions.

In numerous papers, the reaction rate of acetic acid metabolism by methanogenic bacteria (which is frequently suspected as the slowest step in anaerobic digestion) is described by Monod kinetics using total acetic acid concentration as the substrate for catabolism. Some workers tried to include the influence of pH by using only the un-ionized acetic acid as the substrate in a Haldane-kinetic term taking substrate inhibition into account. From this viewpoint, some conclusions regarding reaction engineering aspects of anaerobic waste water treatment are drawn and simple models for the conventional and for the contact process are discussed. The advantage of using support materials for anaerobic bacteria is shown. The space loading can be increased in a two step cascade of fixed bed reactors with external loops for water recycling, with the system being filled with synthetic foam particles as support. (Author's abstract)
W89-01185

EFFECT OF ENVIRONMENTAL CONDITIONS ON THE OCCURRENCE OF MICROTHRIX PARVICELLA IN ACTIVATED SLUDGE,
Agricultural Univ., Wageningen (Netherlands). Dept. of Microbiology.
H. Slijkhuis, and M. H. Deinema.
Water Research WATRAG, Vol. 22, No. 7, p 825-828, July 1988. 1 fig, 2 tab, 11 ref.

Descriptors: *Wastewater treatment, *Domestic wastes, *Oxidation ditches, *Activated sludge, Bulking sludge, *Microthrix, *Growth, Limiting nutrients, Oxygen, Bacteria, Fatty acids, Nitrogen, Sulfur, Glucose, Raw wastewater, Microbiological studies, *Bulking sludge.

The filamentous bacterium Microthrix parvicella often causes poor settling of activated sludge in oxidation ditches supplied with domestic sewage. The effect of nutrient and oxygen supply on the growth of M. parvicella was studied in an experimental activated sludge plant. The organism preferentially utilizes fatty acids as a carbon and energy source and it requires reduced nitrogen and reduced sulfur compounds for growth. In activated sludge fed with a synthetic wastewater containing oleic acid, abundant growth of M. parvicella was obtained in a bench-scale plant operated at a low oxygen concentration. In control plants operated at high oxygen concentration or fed with a synthetic wastewater containing glucose, this organism disappeared. These results may explain the excessive growth of M. parvicella in oxidation ditches supplied with raw domestic sewage as this type of wastewater contains a considerable amount of fatty matter and the process is usually operated at a low oxygen concentration in the mixed liquor. Bulking of sludge caused by M. parvicella can be cured by an enhanced oxygen supply. (Author's abstract)
W89-01217

DETERMINATION OF MICROBIAL KINETIC COEFFICIENTS THROUGH MEASUREMENT OF INITIAL RATES BY RADIOCHEMICAL TECHNIQUES,
Houston Univ., TX. Environmental Engineering Program.
G. E. Speitel, and F. A. DiGiano.
Water Research WATRAG, Vol. 22, No. 7, p 829-835, July 1988. 5 fig, 3 tab, 10 ref. NSF Grant CEE-8213418.

Descriptors: *Wastewater treatment, *Microbiological studies, *Kinetics, *Radiochemical analysis, Chemostats, Monod kinetics, Microbial yield coefficient, Initial-rate measurement, Data acquisition, Endogenous decay coefficient, Phenols, Batch microbial kinetic measurement, Regression analysis.

Microbial kinetic coefficients are usually determined from a series of chemostats operated at different dilution rates; such experiments are time-consuming and labor-intensive. New techniques were developed for the measurement of Monod kinetic coefficients, the yield coefficient, and the endogenous decay coefficient. Kinetic coefficients and the microbial yield coefficient were determined through measurements of initial rates in

short-duration batch experiments using a radioisotopically-labeled phenol substrate. These experimental data were described well by the Monod model. The endogenous decay coefficient was estimated by linear-regression analysis and was within the typical range found by others working with a variety of substrates. The microbial kinetic techniques developed in this research may increase the attractiveness of batch experiments because the approach is faster and easier than chemostat studies. However, a detailed comparison between radiochemical batch and chemostat methods is needed to fully assess the utility of the new techniques. (Author's abstract)
W89-01218

EFFECTS OF CYANIDE AND POLYPHOSPHATES ON ADSORPTION OF METALS FROM SIMULATED AND REAL MIXED-METAL PLATING WASTES,
Washington Univ., Seattle. Dept. of Civil Engineering.
K. R. Nordqvist, M. M. Benjamin, and J. F. Ferguson.
Water Research WATRAG, Vol. 22, No. 7, p 837-846, July 1988. 11 fig, 1 tab, 23 ref. EPA Office of Research and Development Grant EPA 810902-01-0.

Descriptors: *Wastewater treatment, *Metal-finishing wastes, *Heavy metals, *Adsorption, *Cyanide, *Polyphosphates, Chromates, Lead, Copper, Chromium, Nickel, Cadmium, Zinc, Ferrihydrite, Metal complexes, Inhibition, Hydrogen ion concentration.

This study evaluated the effects of chromate, cyanide, pyrophosphate, and tripolyphosphate on the adsorption of Cd, Cu, Cr, Zn, Ni, and Pb onto iron oxyhydroxide. All metals were present simultaneously, along with one of the anions. In the absence of complexing agents, adsorption of the strongest-sorbing metals (Pb, Cu, Cr) slightly inhibited that of the remaining metals when all were present at concentrations of 0.0001 M, and 0.001 M total iron was available as the adsorbent. The presence of up to 0.001 M CrO4 had no significant effect on removal of the cationic metals from solution. Cyanide strongly inhibited sorption of Ni and Cu, but did not affect the other metals. These effects can be explained based on changes in metal speciation when the CN was added. At low concentrations, the polyphosphates enhanced sorption of all the metals, but at high concentration they led to a qualitative change in the metal-sorption behavior. Whereas in the absence of the phosphate ligands, metal sorption is strongly pH-dependent, at high polyphosphate concentration, this dependence almost disappears. Simultaneously, some of the Fe adsorbent dissolves as Fe/P complexes. The effects of metal, chromate and CN concentration do not appear to be major impediments to the utilization of adsorption as a treatment process. The effects of P-containing ligands are more complicated: they may either increase or decrease metal sorption depending on the particular water under study. (Author's abstract)
W89-01219

DETECTION OF ENVIRONMENTAL VIRUSES IN SLUDGE: ENHANCEMENT OF ENTEROVIRUS PLAQUE ASSAY TITERS WITH 5-IODO-2'-DEOXYURIDINE AND COMPARISON TO ADENOVIRUS AND COLIPHAGE TITERS,
Health Effects Research Lab., Cincinnati, OH.
For primary bibliographic entry see Field 5A.
W89-01220

TRANSPORT MODELLING OF BIOLOGICAL TRACERS FROM SEPTIC SYSTEMS,
Wisconsin Univ.-Madison. Water Resources Center.
For primary bibliographic entry see Field 5B.
W89-01226

MECHANISM OF INACTIVATION OF TOBACCO MOSAIC VIRUS WITH OZONE,
Government Industrial Development Lab., Sapporo (Japan).
For primary bibliographic entry see Field 5F.
W89-01229

WATER POLLUTION CONTROL IN DALLAS-FORT WORTH,
Dallas City Water Utilities Dept., TX.
For primary bibliographic entry see Field 5G.
W89-01233

WASTE ALLOCATION SIMULATION MODELS,
Center for Exposure Assessment Modeling, Athens, GA.
R. B. Ambrose, J. P. Connolly, E. Southerland, T. O. Barnwell, and J. L. Schoor.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 9, p 1646-1655, September 1988. 12 tab, 48 ref.

Descriptors: *Waste treatment, *Simulation analysis, *Model studies, *Waste allocation, *Water quality standards, *Water pollution control, *Reviews, Pollutant load, Regulations, Population exposure, Biological oxygen demand, Poisons, Mixing, Chemical properties, Computer programs, Estimation.

Waste-load allocation for toxic pollutants is a recent requirement of EPA regulation. New concepts in water-quality criteria are forcing new approaches to modeling that demand more detail in the analysis process; in particular the inclusion of both frequency as well as duration of exposure in the new criteria require modeling strategies that support such specifications. Both steady-state and dynamic models have been described by various authors. In contrast to conventional pollutants such as BOD, modeling approaches for toxic chemicals involve additional levels of detail. The near-field mixing zone and the far-field transport problems must be addressed to cover the range of potential impacts, both acute and chronic. Indeed, the near-field problem tends to be the critical one for most toxics. Because the chemical properties of toxic chemicals can usually be well defined in laboratory studies, toxics often are modeled from a mechanistic viewpoint. Various physical and chemical properties and their estimation techniques have been incorporated in a number of computer programs that are available for the environmental modeler. These properties allow good definition of the related environmental properties that affect their transport and transformation. Finally, this approach allows more confident extrapolation of modeling estimates to a wider range of conditions. (Shidler-PTT)
W89-01234

REVIEW OF ROCK FILTERS FOR THE UPGRADE OF LAGOON EFFLUENTS,
Tennessee Technological Univ., Cookeville.
E. J. Middlebrooks.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 9, p 1657-1655, September 1988. 11 fig, 6 tab, 14 ref.

Descriptors: *Wastewater treatment, *Rock filters, *Filter media, *Wastewater lagoons, *Effluents, Performance evaluation, Operating costs, Biological oxygen demand, Suspended solids, Design criteria, Algae.

A summary of the design parameters and performance data for rock-filter systems located throughout the United States is presented. Costs of removing algae from lagoon effluents by the use of rock filters are also given. Experience indicates that rock filters perform adequately most of the time with BOD5 and total-suspended-solids effluent concentrations exceeding 30 mg/L, periodically, but not simultaneously; high concentrations are not related to the hydraulic loading rate. Performance inconsistencies indicate that too little is known about the mechanisms involved and the impact of various design parameters. Long-term, well-planned monitoring programs for several rock filters with different design parameters must be conducted before performance can be predicted. (Author's abstract)
W89-01235

ANAEROBIC TREATMENT OF LEACHATE USING FIXED FILM AND SLUDGE BED SYSTEMS,
National Research Council of Canada, Ottawa (Ontario). Div. of Biological Sciences.
K. J. Kennedy, M. F. Hamoda, and S. G. Guiot.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 9, p 1675-1683, September 1988. 8 fig, 5 tab, 20 ref.

Descriptors: *Wastewater treatment, *Water pollution control, *Anaerobic digestion, *Leachates, *Fixed film, *Sludge bed, Landfills, Chemical oxygen demand, Pollution load, Retention time, Heavy metals, Filter media, Biomass, Suspended solids.

Pretreated landfill leachate was successfully treated in anaerobic upflow-blanket-filter (UBF) and downflow-stationary-film (DSF) reactors. The DSF reactor achieved 94% chemical-oxygen-demand (COD) removal at a loading rate of 14.7 kg COD/square m/day and corresponding hydraulic retention time (HRT) of 1.5 days. The UBF reactor, operated similarly, maintained 97% COD removal. An inorganic heavy-metal precipitate formed in both reactors; the precipitate coated the biofilm support in the DSF reactor while in the UBF reactor the precipitate was concentrated in the reactor sludge bed and filter media. Biofilm and sludge granules in both reactors were about 80% fixed solids. Raw untreated leachate, saturated with accumulated biomass, was treated in a UBF at loading rates up to 44 kg COD/square m/day and HRT down to 10 hours. COD removal was in excess of 88%. The maximum specific removal rate of the biomass for this wastewater and reactor configuration was 1.2 kg COD/kg volatile suspended solids/day. (Author's abstract)
W89-01238

NUMERICAL TRANSPORT MODEL FOR OXYGEN- AND NITRATE-BASED RESPIRATION LINKED TO SUBSTRATE AND NUTRIENT AVAILABILITY IN POROUS MEDIA,
Auburn Univ., AL. Dept. of Civil Engineering.
M. A. Widdowson, F. J. Molz, and L. D. Benefield.
Water Resources Research WRERAO, Vol. 24, No. 9, p 1553-1565, September 1988. 13 fig, 2 tab, 44 ref. EPA Contract CR813647010.

Descriptors: *Biodegradation, *Model studies, *Numerical analysis, *Fate of pollutants, *Groundwater pollution, *Nitrates, *Porous media, Simulation, Oxygen, Organic carbon, Microbiological studies, Respiration, Substrates, Limiting nutrients, Heterotrophic bacteria, Ammonium, Mathematical equations, Denitrification.

A model was developed to simulate organic-carbon biodegradation by facultative bacteria in saturated porous media using oxygen-based and/or nitrate-based respiration. Basic assumptions incorporated into the model concept included a simulated particle-bound microbial population comprised of heterotrophic, facultative bacteria in which metabolism was controlled by lack of either an organic-carbon/electron-donor source (substrate), electron acceptor (oxygen and/or nitrate), or mineral nutrient (ammonium), or all three simultaneously. A system of nine coupled nonlinear equations was developed that describe the processes of transport, degradation, and microbial growth and decay. The solution technique was highly resistant to numerical dispersion and oscillation when applied to the advection/dispersion equation, even for large Peclet numbers (100). Microbial utilization of materials was assumed to occur by intrapore-scale diffusion of materials across a diffusion boundary layer separating the particle-bound microcolonies of bacteria from the pore fluid. Denitrifying-enzyme inhibition was modeled as a function of the oxygen concentration associated with the biomass. Simulations of oxygen-based, nitrate-based, and multiple-electron acceptor respiration are presented for a hypothetical experiment using kinetic pa-

rameter-value estimates available from the literature. (Author's abstract)
W89-01251

DRAFTING WATER QUALITY AGREEMENTS,
Smith and Schnacke, Cincinnati, OH.
For primary bibliographic entry see Field 6E.
W89-01253

ACTIVATED SLUDGE SYSTEMS WITH BIOMASS PARTICLE SUPPORT STRUCTURES,
Auburn Univ., AL. Dept. of Civil Engineering.
J. P. Nicol, L. D. Benefield, E. D. Wetzel, and J. A. Heidman.
Biotechnology and Bioengineering BIBIAY, Vol. 31, No. 7, p 682-695, May 1988. 6 fig, 3 tab, 3 ref, append.

Descriptors: *Biological wastewater treatment, *Wastewater treatment, *Activated sludge, *Biomass, *Mathematical models, Simulation studies, Nitrification, Activated sludge process.

A mathematical model was developed to simulate the operation of an activated sludge system with biomass support particles. Based on the results of the simulation study, it would appear that a system with biomass particle supports offers several advantages not offered by conventional systems. These include the ability to resist failure from large hydraulic surges; stable nitrification under transient inhibitory conditions resulting from temperature changes, hydraulic surges, and/or toxic chemicals; and the ability to establish stable operating conditions with respect to both carbon oxidation and nitrification at short hydraulic retention times and low sludge ages. (Author's abstract)
W89-01256

5E. Ultimate Disposal Of Wastes

IMMOBILIZATION OF LEACHABLE TOXIC SOIL POLLUTANTS BY USING OXIDATIVE ENZYMES,
Cook Coll., New Brunswick, NJ. Dept. of Biochemistry and Microbiology.
For primary bibliographic entry see Field 5G.
W89-00341

SOIL SOLUTION IN A SOIL TREATED WITH DIGESTED SEWAGE SLUDGE,
Oxford Univ. (England). Soil Science Lab.
For primary bibliographic entry see Field 5B.
W89-00413

LAND APPLICATION OF DOMESTIC WASTEWATER, WOOD PRODUCTION, AND SLUDGE COMPOSTING: AN ECONOMIC AND ENERGY PRODUCTION ANALYSIS,
Nebraska Univ.-Lincoln. Dept. of Civil Engineering.
G. B. Keefer, M. W. Gilliland, and R. E. Hoffman.
Resources, Conservation and Recycling, Vol 1, p 39-48, March 1988. 5 fig, 3 tab, 16 ref.

Descriptors: *Land disposal, *Domestic wastes, *Sludge, *Economic aspects, *Composting, *Wastewater treatment, Wastewater disposal, Energy, Costs, Trickling filters, Wood wastes.

A wastewater treatment system was analyzed for system costs, energy requirements, and energy production. The system integrates the land application of wastewater on poplar trees with composting of the primary sludge using woodchips from the poplars. System outputs, from which revenue can be generated, include firewood and compost. Costs and energy use were compared with those associated with a traditional system using trickling filters and land disposal of sludge. Additionally, the sensitivity of costs to the discount rate, to revenues from the compost and firewood, and to land prices was evaluated. Results indicated that the innovative system could be economically competitive with the conventional system if some revenues were obtained from the firewood and compost. And, energy use by the innovative system was 35% less than for the conventional system. Comparative costs were most sensitive to land prices and compost revenues, less sensitive to firewood revenues, and showed almost no sensitivity to the discount rate. (Author's abstract)
W89-00465

FLOCCULENT SETTLING ABOVE ZONE SETTLING INTERFACE,
Waterways Experiment Station, Vicksburg, MS.
M. R. Palermo, and E. L. Thackston.
Journal of Environmental Engineering (ASCE) JOEDDU, Vol. 114, No. 4, p 770-783, August 1988. 8 fig, 4 tab, 10 ref.

Descriptors: *Waste disposal, *Spoil disposal, *Flocculation, *Sedimentation, *Sediment-water interfaces, Settling basins, Dredging, Marine sediments, Slurries, Water pollution sources.

Column settling test procedures were used in designing confined dredged material disposal areas for effective sedimentation and initial storage of solids. The results of a study in which the test procedures were refined to allow a prediction of the effluent suspended solids concentration for conditions normally found in the disposal of saltwater sediments are presented. For this case, the dredged material normally settles as a slurry by zone settling, forming a clarified supernatant in the disposal area. The study determined the settling behavior of the fine particles initially remaining in the supernatant and developed procedures for predicting the effluent concentration as a function of retention time and other pertinent operating conditions. The ability to make such predictions is essential to the estimation of total release of contaminants in the effluent from confined disposal sites. (Author's abstract)
W89-00484

FUNDING RESERVE CAPACITY IN WASTEWATER SYSTEMS,
Metropolitan Waste Control Commission, St. Paul, MN.
For primary bibliographic entry see Field 5D.
W89-00506

DEVELOPER FINANCING OF PUBLIC WASTEWATER SERVICE INFRASTRUCTURE,
For primary bibliographic entry see Field 5D.
W89-00507

LOAD ALLOCATION FOR TOXICS USING MONTE CARLO TECHNIQUES,
For primary bibliographic entry see Field 5G.
W89-00514

PROPERTIES OF WATER TREATMENT LIME SLUDGES AND THEIR EFFECTIVENESS AS AGRICULTURAL LIMESTONE SUBSTITUTES,
Ohio State Univ., Columbus. Dept. of Agronomy.
For primary bibliographic entry see Field 5F.
W89-00516

EMISSIONS OF CHLORINATED ORGANICS FROM A MUNICIPAL SEWAGE SLUDGE BURNING INCINERATOR,
Ontario Ministry of the Environment, Rexdale. Lab. Services Branch.
For primary bibliographic entry see Field 5B.
W89-00607

PROCEDURE FOR EVALUATING MUNICIPAL SOLID WASTE LEACHATE COMPONENTS CAPABLE OF CAUSING VOLUME SHRINKAGE IN COMPACTED CLAY SOILS,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
J. P. A. Hettiaratchi, S. E. Hrudey, D. W. Smith, and D. C. C. Sego.
Environmental Technology Letters ETLEDB, Vol. 9, No. 1, p 23-34, January 1988. 5 fig, 3 tab, 13 ref.

Descriptors: *Leachates, *Municipal wastes, *Soil properties, *Landfills, *Water quality management, *Linings, *Clays, Wastes, Solid wastes, Soil types, Sedimentation, Cations, Ions, Bentonite, Free swell difference, Regression analysis, Statistical analysis, Calcium.

A test procedure is presented for evaluating the effect of leachates from municipal solid waste upon the physicochemical interparticle forces and volume change behavior in soils. This procedure can be used to determine the effect of system variables on the volume shrinkage behavior of clay soil liver materials in municipal sanitary landfills. A parameter, free swell difference (FSD), developed from the sedimentation test results, is found useful in identifying soils susceptible to excessive shrinkage in the field. Development of a functional relationship between FSD and several system variables identifies CA(+2) as the major municipal solid waste leachate component responsible for volume shrinkage in soils with high expandable clay mineral contents. (Author's abstract)
W89-00621

EFFECT OF PH AND CONTACT TIME ON THE CONCENTRATION OF AS(III) AND AS(V) IN COAL ASH SYSTEMS,
Georgia Univ., Sapelo Island. Marine Inst.
J. J. Alberts, M. F. Weber, and D. W. Evans.
Environmental Technology Letters ETLEDB, Vol. 9, No. 1, p 63-70, January 1988. 1 fig, 2 tab, 25 ref. US DOE Contract No. EY-76-C-09-0819.

Descriptors: *Path of pollutants, *Leaching, *Acidity, *Arsenic, *Waste disposal, *Coal ash, Hydrogen ion concentration, Adsorption, Savannah River Plant, South Carolina.

The concentrations of As(III) and As(V) were determined as a function of pH and contact time for water/coal ash systems from the Savannah River Plant (South Carolina). Laboratory studies showed that adsorption was the major controller of concentration at all pH values studied. Field studies in a coal ash disposal basin/stream system showed elevated As concentrations in the basin waters, but no increase of As(III) or As(V) in a stream receiving ash basin outflow. As(III) was preferentially removed from solution relative to As(V) in laboratory studies of acidic systems and in field studies at near neutral pH values. (Author's abstract)
W89-00624

COMPARISON OF CO-DIGESTION PERFORMANCE OF TWO DIFFERENTLY COLLECTED ORGANIC FRACTIONS OF MUNICIPAL SOLID WASTE WITH SEWAGE SLUDGES,
Venice Univ. (Italy). Dept. of Environmental Science.
For primary bibliographic entry see Field 5D.
W89-00643

MOBILE FLUME FOR CIRCULAR CHANNEL,
Ecole Polytechnique Federale de Lausanne (Switzerland). Dept. de Genie Civil.
For primary bibliographic entry see Field 7B.
W89-00757

EFFLUENT DISPOSAL AND THE PHYSICAL ENVIRONMENT,
Clyde River Purification Board, East Kilbride (Scotland).
J. C. Curran.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 90, p 97-115, 1986. 9 fig, 3 tab, 11 ref.

Descriptors: *Scotland, *Path of pollutants, *Clyde Estuary, *Firth of Clyde, *Model studies, *Waste disposal, Water pollution control, Estuaries, Tides, Solute transport, Scotland, Sealocks, Radar, Coastal waters, Hydrodynamics.

Some of the hydrodynamic features of the Clyde Estuary and examples are used to emphasize their relevance to an understanding of the effect of pollution on water quality. The Clyde Estuary and

the Firth of Clyde are described in relation to attempts to model effluent movements using computers. Topics discussed are tidal flows, response times, estuary classification, suspended solids, physical factors affecting water quality, discharge to the estuary, hydrodyanamics in sea lochs, dilution and dye studies in the Firth of Clyde, radar trading of drogues and microbiological pollution. (Author's abstract)
W89-00804

USE OF THE CLYDE ESTUARY AND FIRTH FOR THE DISPOSAL OF EFFLUENTS,
Clyde River Purification Board, East Kilbride (Scotland).
A. J. N. Haig.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 90, p 393-405, 1986. 1 fig, 4 tab, 34 ref.

Descriptors: *Scotland, *Effluents, *Clyde Estuary, *Firth of Clyde, *Waste disposal, *Wastewater disposal, *Water pollution sources, Water law, Legal aspects, Estuaries, Water pollution control.

The effluents from about half of Scotland's population and industry drain to the Clyde Estuary and Firth, where they cause a number of problems of contamination and pollution. Historical aspects of urban growth, effluent production and disposal, pollution and pollution control are outlined. The sources, nature, quantities and main effects of effluents discharged are described, as is recent national and international legislation intended to prevent or control pollution. Reference is also made to the determination of license conditions for effluent discharges by means of the Environmental Quality Objective/Environmental Quality Standard approach. (Author's abstract)
W89-00824

LABORATORY STUDY OF THE ACCUMULATION AND TOXICITY OF CONTAMINANTS AT THE SEA SURFACE FROM SEDIMENTS PROPOSED FOR DREDGING,
Battelle Pacific Northwest Labs., Sequim, WA. Marine Research Lab.
J. Q. Word, J. T. Hardy, E. A. Crecelius, and S. L. Kiesser.
Marine Environmental Research, Vol. 23, No. 4, p 325-338, 1987. 6 tab, 31 ref. Contract DE-AC06-76RLO 1830.

Descriptors: *Air-water interfaces, *Spoil banks, *Sediments, *Water pollution effects, *Toxicity, *Bioassay, Aquatic habitats, Reproduction, Coastal waters, Bioindicators, Bays, Estuaries, Dredging, Model studies, Metals, Everett Harbor, Sequim Bay, Urban areas, Sulfides, Fish, Sea surface, Sublethal effects, Embryonic growth stage.

Microcosm laboratory experiments assessed the impact of floatable materials and associated contaminants transported to the surface millilayer (SMIL) after sediments composed of potential dredged materials were disturbed. Urban bay sediments collected from the Everett Harbor, WA, and clean sediments from Sequim Bay, WA, were mechanically disturbed and the resulting floatable fractions transported to the SMIL during a 48-h period were removed for analysis. Sediment, water and SMIL concentrations of organic carbon, suspended solids, a suite of hydrocarbons, metals, sulfides and extractable materials were quantified and compared to EPA's water quality criteria. Bioassay experiments examined the effects produced by exposing sea urchin embryos to these impacted SMIL samples. Contaminants transported to the surface layer within 48 h were 0% to 0.2% of the total mass of contaminants in the test sediments. These experimental results were compared with those predicted by a computer model with reasonably close agreement. Contaminant concentrations in one SMIL impacted by Everett Harbor sediments exceeded EPA water quality criteria limits established for Cu, Zn, Pb, Hg and PAH. The other Everett Harbor sediment sample exceeded the water quality standards for Cu and Pb. Both of these samples were toxic to the developmental phases of sea urchins as shown by the bioassay. According to the numerical model, these SMIL contaminant concentrations would require high dilution ratios before background concentrations could be achieved. The experimental results suggest that dredged material disposal may influence the chemistry and biology of the ocean's surface layer. (Author's abstract)
W89-00858

HORIZONTAL ROUND BUOYANT JET IN SHALLOW WATER,
California Univ., Berkeley. Dept. of Civil Engineering.
R. J. Sobey, A. J. Johnston, and R. D. Keane.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 114, No. 8, p 910-929, August 1988. 9 fig, 2 tab, 18 ref, append.

Descriptors: *Jets, *Outfall, *Hydraulic engineering, *Flow pattern, *Hydraulic models, Shallow water, Buoyancy, Mathematical models, Dispersion.

A common outfall configuration involves a buoyant discharge through a horizontal circular pipe into a shallow body of water. A detailed experimental study of the near-field flow and mixing characteristics was conducted. The proximity of the bed and the free surface has a significant influence on the flow pattern. Experimental results are adequately represented by length and buoyancy scales defined by source momentum and source buoyancy flux. Jet path, centerline dilution and horizontal and vertical half widths are compared with an integral model in an unconfined environment. (Author's abstract)
W89-00902

EFFECTS OF THREE ORGANICS ON SELECTED PHYSICAL PROPERTIES OF TYPE I PORTLAND CEMENT,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
A. Sheffield, S. Makena, M. Tittlebaum, H. Eaton, and F. Cartledge.
Hazardous Waste and Hazardous Materials HWHME2, Vol. 4, No. 3, p 273-286, Summer 1987. 7 fig, 3 tab, 23 ref.

Descriptors: *Compressive strength, *Organic compounds, *Concretes, *Portland cements, *Waste disposal, *Waste stabilization, *Cements, Physicochemical properties, Physical properties, Chemical properties, Polychlorinated biphenyls, Waste treatment.

Stabilization is a process of treating hazardous wastes to limit their toxicity. Cementing materials, such as Portland cement or fly ash, are the principal constituents of most commercial stabilization/solidification techniques. The effect of three organic compounds, ethylene glycol (EG), p-chlorophenol (PCP), and p-bromophenol (PBP), on selected physical properties of Type I Portland cement at 0.4 water/cement ration were studied. Also, possible effects on the cement chemistry were suggested. Curing times of 12 hours, 1 day, 7 days and 28 days were used. Tests for the compressive strength and setting times (initial and final) were performed. Leachability was determined by the USEPA extraction procedure. Organic compounds were added in organic to cement weight ratios of 1:5, 1:10 and 1:25. A control group containing no organics was also prepared. In moderate (1:10) and high (1:5) concentrations, EG was found to inhibit the setting of Portland cement, and significantly decrease the compressive strength. EG samples were found to be easily leachable, with > 80% recovery after 28 days by extraction with water. PCP was found to retard the setting times and decrease the compressive strength (though not as much as EG). Percent recovery of PCP extracted with water was generally high, but lower than EG. PBP had the least effect on setting times, did not decrease the compressive strength significantly (approx. 85% of control strength values), and recovery by extraction was lowest. (Author's abstract)
W89-00994

ESTIMATION OF THE RISK ASSOCIATED WITH THE ORGANIC CONSTITUENTS OF HAZARDOUS AND MUNICIPAL WASTE LANDFILL LEACHATES,
Texas A and M Univ., College Station. Dept. of Soil and Crop Sciences.
For primary bibliographic entry see Field 5B.
W89-00995

DESIGN CRITERIA FOR IN-SITU AND ON-SITE RENOVATION OF AN INDUSTRIAL SLUDGE LAGOON,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Chemical and Biochemical Engineering.
For primary bibliographic entry see Field 5B.
W89-00996

INTERACTION OF EARTHEN LINER MATERIALS WITH INDUSTRIAL WASTE LEACHATE,
Texas Univ. at Austin. Dept. of Civil Engineering.
D. E. Daniel, H. M. Liljestrand, G. P. Broderick, and J. J. Bowders.
Hazardous Waste and Hazardous Materials HWHME2, Vol. 5, No. 2, p 93-108, Spring 1988. 7 fig, 7 tab, 17 ref.

Descriptors: *Leachates, *Industrial wastes, *Landfills, *Hydraulic conductivity, *Groundwater pollution, *Linings, Clay, Reservoirs, Solid wastes, Soil water, Soil contamination, Organic compounds, Chlorinated hydrocarbons, Degradation.

The effect of industrial waste leachate on the hydraulic conductivity of compacted clay soils of the type used in clay liners for waste landfills and impoundments were studied. The liquids used included leachate from an industrial solid-waste landfill, liquids from two industrial waste impoundments, two simulated leachates formulated in the laboratory from reagent-grade organic chemicals, and a laboratory-formulated mixture of one of the impoundment liquids and chlorinated hydrocarbons. Column tests and other techniques were used to investigate waste/soil interactions. None of the liquids increased the hydraulic conductivity of any of the soils. Although concentrated organic liquids can degrade the integrity of clay liners, the dilute organic liquids investigated in this research did not attack or degrade clay liner materials. (Author's abstract)
W89-00997

LEACHING OF INORGANIC HAZARDOUS CONSTITUENTS FROM STABILIZED/SOLIDIFIED HAZARDOUS WASTES,
Cincinnati Univ., OH. Dept. of Civil and Environmental Engineering.
P. L. Bishop.
Hazardous Waste and Hazardous Materials HWHME2, Vol. 5, No. 2, p 129-143, Spring 1988. 8 fig, 32 ref.

Descriptors: *Waste disposal, *Waste stabilization, *Hazardous materials, *Sludge solids, *Leaching, Chemical treatment, Chemical properties, Industrial wastes, Toxicity, Liquid wastes, Landfills, Path of pollutants, Water pollution sources, Pozzolans, Metal complexes.

Stabilization/solidification of hazardous liquids and sludges by a variety of techniques has been investigated as a method of treatment that will bind hazardous materials in a form that minimizes adverse effects on the environment after landfilling. Many of these processes use cement, silicates, flyash and/or other pozzolanic materials to convert the waste to a solid, monolithic form with greatly reduced leaching potential. Currently available leaching tests, such as the U.S. EPA Extraction Procedure or Toxicity Characteristic Leaching Procedure, do not adequately address the potential for leaching or the rate of leaching for waste forms of this type. The metal-binding mechanisms involved in the stabilization/solidification process are discussed. Long term potentials for selected metals are also estimated. (Author's abstract)

W89-00999

TRANSMISSION ELECTRON MICROSCOPIC STUDY OF SOLIDIFIED/STABILIZED ORGANICS,
Louisiana State Univ., Baton Rouge. Hazardous Waste Research Center.
A. C. Chou, H. C. Eaton, F. W. Cartledge, and M. E. Tittlebaum.
Hazardous Waste and Hazardous Materials HWHME2, Vol. 5, No. 2, p 145-153, Spring 1988. 7 fig, 1 tab, 6 ref.

Descriptors: *Hazardous materials, *Solid wastes, *Waste stabilization, *Portland cements, *Chemical reactions, *Electron microscopy, Industrial wastes, Molecular structure, Organic compounds, Clay minerals, Leaching, Crystals.

An understanding of the structure of solidified/stabilized hazardous wastes is important if better stabilized systems are to be designed. Microscopic studies can give information about the mechanisms of waste/solidification matrix interactions. The interactions between organics and Type I Portland cement were studied using transmission electron microscopy. Specimens were prepared from solidified mixtures of cement, water, and either ethylene glycol or p-bromophenol. Using extraction replica methods, weakly embedded, microscopically sized particles were removed from the calcium silicate hydrate (C-S-H) phase of solidified samples and characterized by electron diffraction. There was evidence of interaction between the organics and C-S-H. The amount of tobermoritic material decreased with the addition of either organic; the amount of amorphous material increased. Organics were observed to interact weakly with the highly crystalline Ca(OH)2 and Mg(OH)2 crystals forming a surface phase or coating; the coating produced diffuse diffraction spots. In several cases crystalline compounds were observed with d-spacings not corresponding to those normally found in hydrated Portland cement. (Author's abstract)
W89-01000

EFFECTS OF DISCHARGE FLUCTUATION AND THE ADDITION OF FINE SEDIMENT ON STREAM FISH AND MACROINVERTEBRATES BELOW A WATER-FILTRATION FACILITY,
California Univ., Berkeley. Dept. of Forestry and Resources Management.
For primary bibliographic entry see Field 5C.
W89-01061

DISPOSAL OF RADIUM REMOVED FROM DRINKING WATER,
Wisconsin Dept. of Natural Resources, Madison.
N. A. Hahn.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 7, p 71-78, July 1988. 9 tab, 12 ref.

Descriptors: *Waste disposal, *Water treatment, *Wastewater treatment, *Radium, *Radioisotopes, *Sludge disposal, Ion exchange, Reverse osmosis, Membrane process, Filtration, Sand filters, Lime-soda softening, Landfills, Land disposal, Wastewater disposal, Injection wells, Wisconsin, Illinois, Mathematical equations.

Several options are available for disposal of wastes from treatment of water containing naturally occurring radium. The states, not the U.S. Nuclear Regulatory Commission, regulate this low-level waste. Three types of treatment plant waste are created: wastewater (backwash water brine wastewater, and wastewater treatment plant effluent), sludges (from water treatment and wastewater treatment), and solid waste (from water treatment). Six categories of disposal are as follows: storm sewers or surface water, sanitary sewers, landfills, land application, deep-well injection, and nonsewered wastewater disposal. Wisconsin and Illinois have developed guidelines for disposal of radium-containing wastes. Formulas are provided to control the concentrations and amounts of radioactive wastes released. (Cassar-PTT)

W89-01106

OPERATING A SMALL FULL-SCALE ION EXCHANGE SYSTEM FOR URANIUM REMOVAL,
Arber (Richard P.) Associates, Inc., Denver, CO.
For primary bibliographic entry see Field 5F.
W89-01107

ROLE OF ECONOMIC BENEFITS ANALYSIS IN FUNDING MARINE COMBINED SEWER OVERFLOW PROJECTS - CASE STUDY OF BOSTON HARBOR,
Environmental Protection Agency, Washington, DC.
For primary bibliographic entry see Field 6C.
W89-01132

ASSESSING EFFECTS OF SOIL POLLUTION CONTROL RESIDUALS ON SOIL CHEMISTRY PROPERTIES,
International Process Systems, Inc., Lebanon, CT.
L. M. Naylor.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 8, p 1457-1462, August 1988. 5 fig, 1 tab, 17 ref.

Descriptors: *Land disposal, *Sludge disposal, *Fertilization, *Phosphorus, *Aluminum, *Soil chemistry, *Soil contamination, Residuals, Lime, Agriculture, Alum.

A laboratory soil incubation procedure was developed to assess the fertilization or limiting value of an unknown pollution control residual. The basis of the test is that soil chemical property changes caused by wastes relative to those caused by agricultural materials are similar in the field and laboratory. Test value is illustrated by results from experiments with lime-stabilized and high aluminum-phosphorus sludges. Lime sludge had a liming value equivalent to 25% of agricultural limestone. The phosphorus sludge contained 13% aluminum and 11% phosphorus. Exchangeable aluminum was increased in the soil and exchangeable phosphorus was increased by sludge addition. (Author's abstract)
W89-01140

SEWAGE SLUDGE-SOIL INTERACTIONS AS MEASURED BY PLANT AND SOIL CHEMICAL COMPOSITION,
Hawaii Univ. at Manoa, Honolulu. Dept. of Agronomy and Soil Science.
N. V. Hue, J. A. Silva, and R. Arifin.
Journal of Environmental Quality JEVQAA, Vol. 17, No. 3, p 384-390, July-September 1988. 5 fig, 6 tab, 29 ref.

Descriptors: *Sludge utilization, *Sludge disposal, *Soil-water-plant relationships, *Soil chemistry, Soil types, Fertilization, Lettuce, Copper, Iron, Cadmium, Nickel, Manganese, Phosphorus.

The utilization of sewage sludge on agricultural lands requires prior knowledge of the interactions among sludge, soil, and plant. A greenhouse experiment was conducted on three mineralogically different soils: a limed, volcanic ash-derived Andept (Akaka series, thixotropic, isomesic Typic Hydrandepts), an alkaline Vertisol (Lualualei series, very-fine, montmorillonitic, isohyperthermic Typic Chromusterts) and a limed, manganiferous Oxisol (Wahiawa series, clayey, kaolinitic, isohyperthermic Tropeptic Eutrustox). Each soil received four rates (0, 45, 90, and 180 Mg/ha) of a Honolulu sewage sludge, and an N-P-K fertilizer treatment. Lettuce (Lactuca sativa) was grown as a test crop. Concentrations of plant Cu and Fe were not significantly affected by sludge rate; plant Cd and Zn concentrations increased as sludge rate increased regardless of soil type. Plant Ni remained essentially constant as sludge rate increased in two of the soils; in the Oxisol, plant Ni increased with increasing sludge rate. Manganese in the soil solution drastically increased with sludge rate, and became phytotoxic (plant Mn exceeded 700 mg/kg, a level above which significant yield reduction occurred) with increasing sludge addition in the Oxisol, and with 180 Mg/ha in the Vertisol. The Andept, with its high adsorption capacity, retained most of the heavy metals added by the sludge; this soil also retained phosphate so strongly that P was the growth-limiting factor in all treatments as indicated by low dry-matter yields, low plant P (<1.4 vs. 4.0 mg/kg for maximum yield) and by low soil-solution P concentration (<0.08 vs. 0.40 mg P/L). In terms of heavy metal accumulation in plants, it appeared that the Andept could tolerate the highest sludge loading rate, and the Oxisol the lowest. (See also W89-01169) (Author's abstract)
W89-01161

POSSIBLE MECHANISM FOR MANGANESE PHYTOTOXICITY IN HAWAII SOILS AMENDED WITH A LOW-MANGANESE SEWAGE SLUDGE,
Hawaii Univ. at Manoa, Honolulu. Dept. of Agronomy and Soil Science.
N. V. Hue.
Journal of Environmental Quality JEVQAA, Vol. 17, No. 3, p 473-479, July-September 1988. 1 fig, 5 tab, 30 ref.

Descriptors: *Sludge utilization, *Soil chemistry, *Soil amendments, *Soil-water-plant relationships, *Manganese, *Phytotoxicity, *Metal complexes, *Hawaii, Fertilization, Soil types, Municipal wastes, Lettuce, Hydrogen ion concentration, Oxidation-reduction potential, Tartaric acid, Pyruvic acid, Protocatechuic acid.

Knowledge of sludge-soil interactions is essential for successful utilization of sludges on agricultural lands. To obtain such information, a greenhouse experiment was conducted on three Hawaii soils: an Andept (Typic Hydrandept), a Vertisol (Typic Chromustert), and a manganiferous Oxisol (Tropeptic Eutrustox). Each soil received four rates (0, 20, 40, and 80 g/kg) of a low-manganese municipal sludge. Lettuce (Lactuca sativa) was grown as a test crop. Manganese phytotoxicity unexpectedly occurred in all sludge-amended treatments of the Oxisol and in the 80 g/kg rate of the Vertisol as indicated by reduced dry-matter yields and by high plant-Mn concentrations, which were all greater than 1000 mg Mn/kg. Soil-solution Mn at transplanting significantly increased from 0.02 to 0.46, 5.57, and 7.26 mg Mn/L as sludge rate increased from 0 to 20, 40, and 80 g/kg, despite a concurrent increase in soil pH from 5.43 to 6.78, 7.91, and 8.10. Four weeks later (at harvest), soluble Mn increased even more drastically from 0.01 in the untreated soil to 57, 640, and 1160 mg Mn/L in the 20, 40, and 80 g/kg sludge rate, even though soil pH levels of all sludge treatments were essentially equal (pH 5.0). These facts were virtually inexplicable by soil pH, redox conditions, or the direct Mn contribution from the sludge. In contrast, Mn complexation by organic ligands (e.g., tartaric, pyruvic, protocatechuic acids), which were found in considerable quantities in the soil solutions of sludge-amended soils, accounted for 76 to 99% of the soluble Mn, and adequately explained the high and phytotoxic levels of Mn in soil solutions. (See also W89-01161) (Author's abstract)
W89-01169

WASTE ALLOCATION SIMULATION MODELS,
Center for Exposure Assessment Modeling, Athens, GA.
For primary bibliographic entry see Field 5D.
W89-01234

5F. Water Treatment and Quality Alteration

SYSTEMS APPROACH TO NITRATE REMOVAL FROM GROUNDWATER SUPPLIES,
Nebraska Univ.-Lincoln. Dept. of Civil Engineering.
M. F. Dahab, and I. Bogardi.
Journal of Environmental Systems JEVSB, Vol. 17, No. 4, p 291-303, 1987-88. 4 fig, 20 ref.

Descriptors: *Water treatment, *Groundwater pollution, *Systems analysis, *Nitrates, Nutrient removal, Water quality standards, Human pathology, Public health, Optimization, Cost analysis, Cost-benefit analysis.

Nitrate concentrations in groundwater supplies in many areas have steadily increased past the standard established by the Safe Drinking Water Act. Nitrate contamination is linked to infant methemoglobinemia as well as the formation of n-nitroso compounds which are etiologic agents for gastric cancer in humans. The feasibility of removing nitrates from groundwater supplies was examined. Systems analysis was used to determine the best (i.e., optimal) scenarios under which one, or a combination, of several available processes can be applied. A systems methodology for selecting cost-effective nitrate treatment strategies is outlined. Nitrate removal relationships and cost of treatment functions were developed. The systems methodology is illustrated for a typical midwestern community facing nitrate contamination problems. (Author's abstract)
W89-00134

INDICATORY ROLE OF SOME INVERTEBRATES FOR QUALITY OF WATER IN THE VISTULA RIVER AND IN SUBSEQUENT STAGES OF ITS TREATMENT,
Polish Academy of Sciences, Lomianki. Inst. Ekologii.
For primary bibliographic entry see Field 5A.
W89-00236

GUINEA WORM DISEASE IN NORTHERN UGANDA: A MAJOR PUBLIC HEALTH PROBLEM CONTROLLABLE THROUGH AN EFFECTIVE WATER PROGRAMME,
United Nations Children's Fund, Kampala (Uganda).
P. L. Henderson, R. E. Fontaine, and G. Kyeyune.
International Journal of Epidemiology IJEPBF, Vol. 17, No. 2, p 434-440, June 1988. 2 fig, 2 tab, 21 ref.

Descriptors: *Uganda, *Public health, *Epidemiology, *Drinking water, *Guinea worm disease, *Diseases, *Human diseases, Infection, Seasonal variation, Ponds, Reservoirs, Rivers, Water tanks, Surveys, Parasites, Dracunculiasis.

A modified survey was conducted in northwestern Uganda in 1984 to provide descriptive epidemiological data on dracunculiasis in a water program target area. A total of 2014 people participated from 58 randomly selected clusters. Interviewers elicited information on age and sex of household members as well as number, date of emergence and location of Guinea worms, and type and distance from water source in an endemic area. The survey yielded an incidence rate of 193 cases per 1000 people per year and a prevalence rate of 43 active cases per 1000. Respondents who reported using ponds, reservoirs, valley tanks or rivers as their primary water source had the highest attack rates; those using boreholes had the lowest rate. Adolescents and adults differed little in risk, but the disease was less common among young children. Guinea worm disease displayed a bimodal seasonal pattern. It was concluded that the survey method used for determining dracunculiasis incidence was appropriate in this setting. The incidence of this disease may be significantly reduced in Uganda through the country's commitment to the International Drinking Water Supply and Sanitation Decade. (Author's abstract)
W89-00278

GENERAL WATER SUPPLY SYSTEM SIMULATION MODEL: WASP,
Newcastle Univ. (Australia). Dept. of Civil Engineering.
G. Kuczera, and G. Diment.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 114, No. 4, p 365-382, July 1988. 8 fig, 13 ref, 2 append.

Descriptors: *Water supply, *WASP, *Computer models, *Simulation analysis, *Water management, Model studies, Water conveyance, Computer programs, Networks, Management planning, Case studies, Computers.

WASP is a mass-balance quasi-simulation computer package developed to facilitate analysis of the performance of the headworks and transfer components of a water supply system under different operating policies and changes to system configuration. Its generality is due to the use of a network linear programs (LP) which allows system components to be connected in virtually any configuration. The user defines an operating policy in terms of early understood rules which guide the network LP when it makes seasonal assignments of water within the water supply system. WASP is based on a network LP to take advantage of computer codes up to 100 times faster than standard LP codes. The principles used to formulate the network LP are discussed and a case study is presented which involves a complex urban water supply system to demonstrate the generality of WASP. The input/output features of WASP which streamline its use are reviewed. (Author's abstract)
W89-00299

NATIONAL FIELD EVALUATION OF A DEFINED SUBSTRATE METHOD FOR THE SIMULTANEOUS ENUMERATION OF TOTAL COLIFORMS AND ESCHERICHIA COLI FROM DRINKING WATER: COMPARISON WITH THE STANDARD MULTIPLE TUBE FERMENTATION METHOD,
Yale Univ., New Haven, CT. School of Medicine.
For primary bibliographic entry see Field 5A.
W89-00337

INCIDENCE OF COLIPHAGE IN POTABLE WATER SUPPLIES,
National Research Centre, Cairo (Egypt). Water Pollution Control Lab.
M. M. El-Abagy, B. J. Dutka, and M. Kamel.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 6, p 1632-1633, June 1988. 9 ref. 1 tab.

Descriptors: *Coliphage, *Coliforms, *Egypt, *Drinking water, *Bacterial analysis, Pathogens, Potable water, Water sampling, Enteroviruses, Cairo, Viruses.

Samples of drinking water from different sources in greater Cairo, Egypt, and bottled drinking water were tested for total coliform, fecal coliform, and coliphage populations. Of the 147 samples tested, 4 samples were positive for both total coliforms and coliphage, 65 samples were negative for total coliforms and fecal coliforms. The incidence of coliphage in these potable water supplies reflects the probability of human pathogenic virus survival in these waters also. On the basis of these and earlier reported data, it is recommended that the coliphage test should be included as part of any potable water testing scheme to protect the unwary consumer. (Author's abstract)
W89-00338

EFFICACY OF CHEMICAL DOSING METHODS FOR ISOLATING NONTUBERCULOUS MYCOBACTERIA FROM WATER SUPPLIES OF DIALYSIS CENTERS,
Center for Infectious Diseases, Atlanta, GA. Hospital Infections Program.
For primary bibliographic entry see Field 5A.
W89-00343

WATER/WASTEWATER FACILITIES GET BETTER WITH ELECTRONICS,
Groveland Community Services District, CA.
For primary bibliographic entry see Field 5D.
W89-00392

FATE OF ALACHLOR DURING TREATMENT OF PUBLIC WATER SUPPLIES,
Emporia State Univ., KS. Dept. of Chemistry.
D. C. Schroeder.
Transactions of the Kansas Academy of Science, Vol. 90, No. 1-2, p 41-45, 1987. 3 tab, 5 ref.

Descriptors: *Alachlor, *Fate of pollutants, *Water treatment, *Activated carbon, Herbicides, Neosho River, Kansas, Chlorination, Water softening, Flocculation, Alum, Filtration, Odor control, Anthracite, Performance evaluation.

The herbicide alachlor was added to Neosho River water samples and subjected to a typical treatment sequence used for treatment of public water supplies in Kansas. No significant alachlor removal was caused by chlorination, lime-soda softening, alum flocculation, or sand filtration. Partial removal was achieved when anthracite was used in filtration. Activated carbon in batch treatment for taste and odor removed 70-80% of the alachlor. Granular activated carbon used in filtration removed alachlor to below the detection limit. These results indicate the need for routine activated carbon treatment of public water supplies to prevent public exposure to alachlor. (Author's abstract)
W89-00395

EXPERIENCES OF LONG-TERM DESTRATIFICATION IN A WATER SUPPLY IMPOUNDMENT IN CENTRAL ILLINOIS,
Illinois State Water Survey, Peoria. Water Quality Section.
For primary bibliographic entry see Field 5G.
W89-00403

NETWORKING URBAN WATER SUPPLIES IN WEST AFRICA,
Minnesota Univ., St. Paul. Coll. of Forestry.
J. A. Perry.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 6, p 34-42, June 1988. 1 tab, 39 ref. University of Minnesota Agricultural Experiment Station Project 42-025.

Descriptors: *Networks, *Africa, *Urban areas, *Water supply, *Water management, *Regional planning, *Water distribution, Ivory Coast, Ghana, Burkina Faso, Liberia, Water conveyance, Management planning, Public utility districts, Information exchange, Water quality.

The diversity among four West African water supply systems is characterized, and problems faced by managers of these kinds of utilities are outlined. After having interviewed municipal water system managers in the Ivory Coast, Ghana, Burkina Faso, and Liberia, the author describes physical facilities, monitoring and analysis operations, and the regulatory framework within which each system operates. Avenues of development that could improve the quality of regional water supplies include professional networks and twinning with utilities in the developed world. Such arrangements could provide a forum for exchange of resources among people addressing similar problems. Other productive avenues of change are development of information management systems for water quality data, improved performance indicators for inplant processes or community-level social services, and development of innovative management techniques. A significant role in developing such changes can be played by utility operators in developed countries. That role includes short- and long-term training to be provided in host countries or in schools and water supply systems in developed countries. (Lantz-PTT)
W89-00419

USING MORINGA SEEDS AS COAGULANTS IN DEVELOPING COUNTRIES,
Deutsche Gesellschaft fuer Technische Zusammenarbeit G.m.b.H., Eschborn (Germany, F.R.). Water Purification Project.
S. A. A. Jahn.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 6, p 43-50, June 1988. 2 fig, 2 tab, 21 ref.

Descriptors: *Moringa seed, *Water treatment, *Coagulation, *Developing countries, Flocculation, Domestic water, Seeds, Economic aspects.

A few traditional plant flocculants such as Moringa seeds acting as primary coagulants have been

recommended for domestic water treatment in rural areas of Africa and Asia, conventional coagulants are too expensive and water treatment technicians are lacking. Because M. oleifera is also found in the Americas, there has been recent interest in introducing Moringa seeds as flocculants to Guatemala and Mexico. Other countries of the region with similar environmental conditions might benefit from this coagulant as well. Furthermore, seeds from wild African Moringaceae such as M. stenopetala have similar flocculating properties. This species is likely to offer even greater coagulant yields per tree and per available plantation area in the long term. To guarantee coagulant supplies of high quality, along with speedy fruit production, big seed size, and rich yields, cultivation all over the tropical belt should be coordinated by global exchange of seed materials from the most suitable clones, special breeding efforts in specific scientific stations, and subsequent local application of vegetative propagation and grafting. (Lantz-PTT)
W89-00420

CENTRAL SOFTENING BY CRYSTALLIZATION IN A FLUIDIZED-BED PROCESS,
Amsterdam Water Supply (Netherlands).
C. Van der Veen, and A. Graveland.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 6, p 51-58, June 1988. 9 fig, 1 tab, 12 ref.

Descriptors: *Water treatment, *Water softening, *Crystallization, *Fluidized bed process, *Chemical treatment, Amsterdam, Water supply, Drinking water, Caustic soda, Calcium carbonate, Hydrogen ion concentration, Copper, Lead, Heavy metals, Phosphates, Denitrification, Costs.

Water softening installations at Amsterdam (the Netherlands) Water Supply's two main drinking water treatment plants reduce hardness from 250 to 150 mg as CaCO3/L. In this softening process, pH is raised by adding caustic soda to produce calcium carbonate, which crystallizes on seeding grains in a fluidized bed within a cylindrical reactor. The process, which is not temperature sensitive, allows intensive mixing of water and caustic soda without causing turbidity, and sodium concentrations are not raised above regulatory guidelines. The only by-product of the process, which is stable and makes few demands in terms of operation and maintenance, is recyclable seed grains layered with calcite. Additionally, increased pH lowers lead and copper solubility by factors of 2 and 5, respectively, and the process can be used to remove heavy metals and phosphates and for denitrification. Total investment and operations cost is equivalent to $4 per household per year, and total savings on household detergents, soaps, energy, and maintenance are equivalent to $25-$40 per household per year. (Author's abstract)
W89-00421

IMPROVING WATER SUPPLY IN THAILAND,
Waterworks Authority, Bangkok (Thailand).
S. Orvichian, P. Chuaphanich, and S. Kawamura.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 6, p 59-66, June 1988. 8 fig, 2 tab.

Descriptors: *Management planning, *Water treatment facilities, *Water supply, *Thailand, *Water management, *Water quality control, Economic aspects, Costs, Performance evaluation, Flocculation, Coagulation, Sedimentation tanks, Chemical treatment.

Recognizing the clear relationship between a clean water supply and the prevention of waterborne disease, the government of Thailand is stressing the need for safe water in its current economic and social development plan. One of the two major water supply agencies in Thailand, the Provincial Waterworks Authority, is handling the task of improving water quality and doubling plant output with minimum capital expenditure. This article describes how existing plant capacities were doubled without the addition of new basins and filters, but rather by these recommended modifications: Stage 1--correct existing deficiencies and implement those modifications needing immediate action (coagulation, flocculation, filtration, sedimentation tanks, and chemical feeding system); Stage 2--expand plant capacity at the earliest possible time; and Stage 3--modernize plants and improve safety. Following the implementation of these steps, performance evaluations were conducted. (Lantz-PTT)
W89-00422

DEVELOPMENT AND MANAGEMENT OF GROUNDWATER RESOURCES ON DIEGO GARCIA,
Naval Facilities Engineering Command, Pearl Harbor, HI. Pacific Div.
For primary bibliographic entry see Field 4B.
W89-00423

TWINNING: UTILITY PAIRING,
Water and Sewage Authority, Castries (St. Lucia).
J. M. Calixte, and H. Sanchez.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 6, p 73-76, June 1988. 5 fig.

Descriptors: *Twinning, *Public utility districts, *St. Lucia, *Management planning, *Water supply, *Water treatment facilities, Institutions, Water costs, Pricing, Automation, Long-term planning, Education.

The St. Lucia Central Water Authority, a struggling utility on a rapidly developing island in the Caribbean, paired with the Wessex Water Authority (WWA) of the United Kingdom to solve its engineering, accounting, and managerial difficulties. The twinning partnership was not set up to be terminated abruptly. At its inception, a mechanism of evaluation, in the form of monitoring over a period of two years, was built into the agreement. The cost of the twinning over the period of its existence (1980-87) was about 250,000 pounds sterling. A complete reorganization and streamlining of the operations of the authority were achieved by the end of the first stage of the twinning. One of the first achievements of the management team was the piloting of the authority's submission to the public utilities commission for a rate increase. It is to the credit of the WWA that the following improvement plans and programs, conceived long before the twinning was envisioned, were in fact implemented during its two and a half years with the authority: computerization of billing; water quality improvements and increased surveillance; preparation of south island water supply survey; automation of equipment for energy savings; pumping plant replacement programs to realize energy savings; use of level control resulting in better management of the distribution systems; preparation of long-term development plants; staff training and general improvement in morale; greater reliability of service following acquisition of standby generator power; and, improved response time to complaints - resulting from improved communication and establishment of a control room. (Lantz-PTT)
W89-00424

CONTROLLING SWAMPY ODORS IN DRINKING WATER,
Kinhill Engineers, Perth (Australia).
J. E. Wajon, B. V. Kavanagh, R. I. Kagi, R. S. Rosich, and R. Alexander.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 6, p 77-83, June 1988. 5 fig, 2 tab, 55 ref.

Descriptors: *Chlorination, *Drinking water, *Odor control, *Water treatment, Perth, Australia, Groundwater quality, Dimethyl trisulfide, Chlorine, Water quality control.

Swampy odors occurred in some areas of Perth, Western Australia, supplied with treated groundwater. The odors, caused by dimethyl trisulfide, developed in the water supply mains when chlorine demand was not satisfied. When swampy odors occurred, flushing of water mains reduced the number of complaints. The addition of 2 mg/L or more of chlorine also eliminated the swampy odor. To control the formation of swampy odors in mains, an extra 2-5 mg chlorine/L was added at the outlet of the groundwater treatment plant, thereby increasing the concentration of free chlorine at most points in the water supply system. Since this strategy was instituted, complaints of swampy odors have almost ceased. (Author's abstract)
W89-00425

TRIHALOMETHANE FORMATION IN HIGH-BROMIDE LAKE GALILEE WATER,
Technion - Israel Inst. of Tech., Haifa.
M. Rebhun, J. Manka, and A. Zilberman.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 6, p 84-89, June 1988. 8 fig, 4 tab, 17 ref.

Descriptors: *Sea of Galilee, *Bromides, *Trihalomethanes, *Water quality, *Water treatment, Israel, Volatilization, Chlorine, Reservoirs, Oxidation, Ammonia, Chemical reactions.

A study was conducted of trihalomethane (THM) levels in Israel's national water supply system, which is composed of open channels, open operational reservoirs, and a long, closed conduit. The system derives its water from Lake Galilee. Because of the high bromide concentration in the lake, bromoform is the dominant THM formed. Significant volatilization of THMs was observed in the open channels, and the major production of THMs occurred in the closed conduit. Bromoform is the dominant THM species formed during chlorination of high-bromide water; it accounts for about 90% of THMs, the remaining THMs being dibromochloromethane and bromodichloromethane, with very little chloroform. This THM distribution is due to the fact that oxidation of bromide to bromine (by chlorine) is a much faster reaction than the reaction of chlorine with precursors to produce chloroform. In the presence of ammonia and bromide, a series of kinetically competing reactions is involved. Up to the peak of the breakpoint chlorination curve, the fastest reaction is monochloramine formation; therefore, low concentrations of THMs are expected. After the peak, at which point monochloramine formation is complete, oxidation of bromide to bromine kinetically outcompetes the formation of dichloramine. The bromine produced, being the dominant halogen in this region, reacts with precursors to produce bromoform. Beyond the breakpoint, where free residual halogen is present, bromine is the dominant halogen up to molar ratios of (residual active halogen) to (bromide) = 1. In the bromide-rich lake water described here, this corresponds to a free halogen residual of 1 mg/L, covering the whole practical range of free residuals and resulting in bromoform being the dominant THM in the water system. (Lantz-PTT)
W89-00426

EVALUATING THE MODIFICATIONS TO THE MF TOTAL COLIFORM METHOD FOR DRINKING WATER WITH HIGH NONCOLIFORM BACKGROUNDS,
Wisconsin State Lab. of Hygiene, Madison.
For primary bibliographic entry see Field 5A.
W89-00427

GROWTH KINETICS OF HYDROXIDE FLOCS,
British Aerospace Aircraft Group, Kingston upon Thames (England).
R. J. Francois.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 6, p 92-96, June 1988. 6 fig, 3 tab, 20 ref.

Descriptors: *Water treatment, *Growth kinetics, *Flocculation, *Aluminum sulfate, Mathematical studies, Chemical treatment, Hydrogen ion concentration, Temperature, Suspended solids, Coagulation, Wastewater treatment.

The kinetics of a coagulation-flocculation process that uses aluminum sulfate as the coagulant can be quantified by a rate constant, a collision efficiency factor, floc growth constants, and the floc buildup time. The experimental procedure yields the rate

constant, which expresses the diminution of primary particles. The rate constant is inversely proportional to the floc buildup time and can be raised by using higher mixing intensities, a longer rapid-mixing period, a higher concentration of suspended solids, or a higher coagulant dosage. An increase in temperature or pH also raises the rate constant. The collision efficiency factor decreases with time, is strongly influenced by the floc structure, and correlates strongly with the ratio between rate constant and sludge index. A quantification of floc growth by growth constants is given, and a physical interpretation of the growth constants is proposed. The first constant expresses the rate of floc growth caused by adsorption coagulation, whereas the second constant quantifies undisturbed growth by enmeshment. A third growth constant may be used during a short period. After the third phase, the rate of growth decreases to zero. Growth rate is promoted by an increase in coagulant dosage, an increased rapid-mixing time, or a higher pH. Growth constants correlate with floc buildup time. The coagulant dosage and the pH are the most important parameters influencing floc buildup time. A too short or too long rapid-mixing period reduces the rate of floc growth, thus increasing floc buildup time. An increase in the velocity gradient during slow mixing reduces the floc buildup time. (Lantz-PTT)
W89-00428

LEGIONNAIRE'S DISEASE IN A JOHANNESBURG TEACHING HOSPITAL,
Department of National Health and Population Development, Pretoria (South Africa).
P. M. Strebel, J. M. Ramos, I. J. Eidelman, L. Tobiansky, and H. J. Koornhof.
South African Medical Journal SMJOAV, Vol. 73, No. 6, p 329-333, March 19, 1988. 3 fig, 3 tab, 32 ref.

Descriptors: *Legionnaire's disease, *Johannesburg, *Public health, *Water treatment, South Africa, Hospitals, Water quality, Microbiological studies, Human treatment.

During the period 11 November 1985 - 21 February 1986, 12 cases of Legionnaire's disease were identified at a Johannesburg teaching hospital. Only two patients definitely acquired the disease in hospital. Both responded well to treatment. An epidemiological investigation was initiated to determine the source of infection and mode of transmission of the causative agent (Legionella pneumophila), which may be recovered from a wide variety of water sources. Although L. pneumophila was cultured from the hospital hot-water system, there was no association between the location of patients and culture-positive water sites. Cases were clustered in the medical and surgical intensive care units. Being on a ventilator was a significant risk factor for acquiring Legionnaires' disease (relative risk 18,4; 95% confidence interval 2,4 - 142,2). The potential role of ventilators in the transmission of the disease is discussed together with the infection control measures adopted to interrupt the outbreak. (Author's abstract)
W89-00450

PROGRAMMING MODEL FOR THE OPTIMAL PLANNING OF WATER SUPPLY SYSTEMS,
Natal Univ., Durban (South Africa). Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W89-00452

HOW SAFE IS YOUR WATER PLANT,
Gretna, LA.
E. S. Fugier.
Southwest and Texas Water Works Journal, Vol. 70, No. 4, p 6, July 1988.

Descriptors: *Safety, *Security, *Water treatment facilities, Water management, Management planning, Maintenance, Public health.

The safety of employees, equipment, the water supply, and the liability exposure caused by allowing easy access to the water plant should be foremost in the minds of management. Water, as any other product that is sold to the consumer, must be safeguarded. The major factors involved in safe potable water production are: a well-trained, responsible operator, a successful quality control program, responsible management that demands a quality product and sets the example for the employees, and last, proper safety and security of the water production plant. The water plant operator's office or control room should allow for observation of all areas of the water plant. In addition, electrically operated gates controlled by the operator are recommended. Safety and security of the water plant should be part of all training programs for water department employees. The employees must be made aware of their responsibilities to the public they serve, and the consequence of a contaminated water supply system. (Lantz-PTT)
W89-00462

BINDING AND REMOVAL OF ALUMINUM IONS IN WATERS BY AN ALGAL BIOMASS.
California State Polytechnic Univ., Pomona. Dept. of Chemistry.
P. R. Zimnik, and J. Sneddon.
Analytical Letters ANALBP, Vol. 21, No. 8, p 1383-1396, August 1988. 6 fig, 2 tab, 9 ref.

Descriptors: *Water treatment, *Aluminum, *Algae, *Biological treatment, Ions, Biomass, Human diseases, Alum, Filtration, Water districts, Chlorophyta, Chlorella, Hydrogen ion concentration, Suspended solids, Salinity.

Accumulation of aluminum in the hypothalmic region of the brain has been suggested as a contributing agent in the development of Alzheimer's disease, though data on this link is still inconclusive. An aluminum compound, alum, is added in the filtration process of many water districts in the U S. A preliminary study on the binding and removal of trace concentrations of aluminum ions by two species of algae, Chlorella pyrenoidosa and C. vulgaris, was conducted. Binding by C. pyrenoidosa was minimal over all pH ranges, but binding by C. vulgaris was effective with a maximum of 68% occurring at pH 5. Binding was drastically lowered below pH 2; this may be used to remove aluminum from the algae. Optimum binding occurred after 20 minutes exposure to aluminum solution and with 450 mg algae mass to 100 ml solution. Binding was reproducible and more efficient in waters with low suspended solids. High salt concentrations interfere with binding. C. vulgaris could be reused 7 times with washings between each binding before a noticeable decrease in binding efficiency was found. (Author's abstract)
W89-00478

CONTAMINANT PROPAGATION IN DISTRIBUTION SYSTEMS,
Environmental Protection Agency, Cincinnati, OH. Office of Research and Development.
R. M. Clark, W. M. Grayman, and R. M. Males.
Journal of Environmental Engineering (ASCE) JOEDDU, Vol. 114, No. 4, p 929-943, August 1988. 9 fig, 1 tab, 12 ref.

Descriptors: *Water distribution, *Path of pollutants, *Water mains, Water quality, Drinking water, Interagency cooperation, Model studies, Hydraulic models, Water users, Pennsylvania.

In order to study the factors that cause water-quality variations in drinking-water distribution systems, the Drinking Water Research Division of the EPA initiated a cooperative agreement with the North Penn Water Authority, Lansdale, PA. This agreement resulted in a series of field-monitoring and systems-modeling studies that provided insight into the movement of contaminants in distribution systems. Previous studies had developed a steady-state model, a quasi-steady-state model, and a dynamic model that provided useful approaches to modeling the general propagation of contaminants in distribution systems. The steady-state model was used to examine the actual pathways of water flow, the time of passage, and percentage of water that flows from a given source to a given node in a distribution system. The contaminant-propagation technique developed from this extension of the steady-state model provided a useful technique for analyzing many of the factors that affect water quality in a distribution system. Moreover, this research pointed out the importance of adequate hydraulic modeling of the systems being studied and the importance of field studies in verifying system performance. The approach suggested in this study provides useful insight into the water-quality variations that may impact consumers at the tap and the development of time- and spatially-sensitive monitoring strategies. (Author's abstract)
W89-00494

GAC TREATMENT COST EXPERIENCE AT TWO DRINKING WATER UTILITIES,
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
J. Q. Adams, R. M. Clark, B. W. Lykins, J. DeMarco, and D. Kittredge.
Journal of Environmental Engineering (ASCE) JOEDDU, Vol. 114, No. 4, p 944-961, August 1988. 10 tab, 5 ref.

Descriptors: *Water treatment, *Activated carbon, *Capital costs, *Operating costs, *Water treatment facilities, *Utilities, Field tests, Reactivation, Maintenance costs, Cincinnati, Ohio, Manchester, New Hampshire.

Because of extensive interest in the use of granular activated carbon (GAC) for drinking-water treatment, the EPA's Drinking Water Research Division sponsored several field-scale research projects to demonstrate its use. Two of these projects, one at the Cincinnati (OH) Water Works and the other at the Manchester (NH) Water Works, yielded extensive information on capital and operating costs. Both projects utilized fluid-bed reactivation, and deep-bed contactors were constructed at Cincinnati. It was found that fluid-bed reactivation represented approximately 30% of the capital costs and 70% of the operations and maintenance costs. Carbon-loss rates ranged from about 11 to 23% and represented the largest individual cost item in the GAC-reactivation system. In cooperation with three smaller utilities, regional reactivation was studied at Manchester; regionalization was found to be cost-effective for these systems. (Author's abstract)
W89-00495

PROPERTIES OF WATER TREATMENT LIME SLUDGES AND THEIR EFFECTIVENESS AS AGRICULTURAL LIMESTONE SUBSTITUTES,
Ohio State Univ., Columbus. Dept. of Agronomy.
M. D. Che, T. J. Logan, S. J. Traina, and J. M. Bigham.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 5, p 674-680, May 1988. 6 tab, 18 ref.

Descriptors: *Sludge disposal, *Water softening, *Lime, *Soil amendments, *Agricultural chemicals, *Water treatment, *Sludge, *Limestone, Lagoons, Soil chemistry, Physicochemical properties, Agriculture, Water reuse, Alkalinity, Mineralogy, Neutralization.

Lagoon lime sludges were analyzed for a variety of physical, chemical, and mineralogical properties, including calcium carbonate equivalent and fineness. Sludge and agricultural grade limestone samples were incubated in the laboratory after mixing with a loamy sand soil material, and soil pH changes were monitored. Lime sludges increased soil pH more than agricultural limestone. Final soil pHs were higher with sludges having higher calcium carbonate equivalent and total fineness efficiency. Study results indicate that water treatment lime sludges can effectively substitute for ground agricultural limestone soils. (Author's abstract)
W89-00516

EFFECT OF PERMANGANATE OXIDATION AND CHLORINATION ON THE MUTAGENIC ACTIVITY AND OTHER QUALITY PARAMETERS OF ARTIFICIALLY RECHARGED

GROUND WATER PROCESSED FROM HUMUS-RICH SURFACE WATER,
National Public Health Inst., Kuopio (Finland). Kuopio Regional Inst.
T. Vartiainen, A. Liimatainen, P. Keranen, T. Ala-Peijari, and P. Kalliokoski.
Chemosphere CMSHAF, Vol. 16, No. 7, p 1489-1499, 1987. 4 fig, 4 tab, 17 ref.

Descriptors: *Water treatment, *Groundwater, *Disinfection, *Oxidation, *Chlorination, *Mutagens, *Humic acids, Disinfection, Potassium permanganate, Artificial recharge, Recharge, Oxygen, Organic matter, Iron, Manganese, Drinking water, Water quality, Decomposing organic matter.

The effect of oxygen, chlorine, and potassium permanganate oxidation on the quality of drinking water processed from artificially recharged groundwater was studied. Artificially recharged groundwater contained only 45% of the organic material of the original lake water, but iron and manganese contents were high. Oxygen removed iron, but not manganese. Potassium permanganate proved to be more effective than chlorine in removing manganese. The non-chlorinated waters were nonmutagenic, but the levels of the mutagenicity of all chlorinated, artificially recharged groundwaters were as high as in chlorinated drinking water processed from lake water. One exception was found, however. The mutagenicity of potassium permanganate oxidized, chlorinated, artificially recharged groundwater was very low, only about 5% of the other waters. (Author's abstract)
W89-00599

DESTRUCTION OF POLYCHLORINATED DIBENZO-P-DIOXINS AND DIBENZOFURANS IN CONTAMINATED WATER SAMPLES USING OZONE,
Institut Fresenius Chemische und Biologische Laboratorien G.m.b.H., Taunusstein-Neuhof (Germany, F.R.).
For primary bibliographic entry see Field 5D.
W89-00606

INVESTIGATION OF THE PRODUCTION OF LIPOPHILIC VOLATILE ORGANOHALOGEN MATERIALS DURING LABORATORY CHLORINATION OF SOME GROUND WATER SAMPLES FROM YUGOSLAVIA,
Institut Rudjer Boskovic, Zagreb (Yugoslavia). Center for Marine Research.
M. Picer, V. Hocenski, and N. Picer.
Chemosphere CMSHAF, Vol. 16, Nos. 10-12, p 2279-2289, 1987. 3 fig, 3 tab, 22 ref.

Descriptors: *Water treatment, *Water pollution sources, *Chlorinated hydrocarbons, *Chlorination, *Organic matter, Humic acids, Groundwater, Yugoslavia, Halomethanes.

The relationship between concentration of organic matter in groundwater samples from Yugoslavia and the volatile organohalogen compounds produced upon chlorination was studied. The concentrations of the volatile organohalogen compounds formed after chlorination are in most samples higher than the concentrations of these materials before the chlorination process. The levels of identified organohalogens produced during chlorination are similar for all investigated water samples. The concentration of unidentified materials is significantly higher in polluted groundwater than in water less contaminated with organic materials. Slightly positive correlations were found between the concentrations of organic matter in groundwater samples with higher levels of these materials and the production of unidentified organohalogens. No correlation was found for the identified organohalogens. (Cassar-PTT)
W89-00608

COMPARISON OF DRINKING WATER MUTAGENICITY WITH LEACHING OF POLYCYCLIC AROMATIC HYDROCARBONS FROM WATER DISTRIBUTION PIPES,
Syracuse Research Corp., NY. Life and Environmental Sciences Div.
For primary bibliographic entry see Field 5C.
W89-00619

CHLOROPICRIN IN POTABLE WATER: CONDITIONS OF FORMATION AND PRODUCTION DURING TREATMENT PROCESSES (LA CHLOROPICRINE DANS LES EAUX POTABLES: CONDITIONS DE FORMATION ET EVOLUTION LE LONG DES FILIERES DE TRAITEMENT),
Centre de Recherche Lyonnaise des Eaux - Degremont, Le Pecq (France).
J. P. Duguet, Y. Tsutsumi, A. Bruchet, and J. Mallevialle.
Environmental Technology Letters ETLEDB, Vol. 9, No. 4, p 299-310, April 1988. 8 fig, 5 tab, 7 ref. English summary.

Descriptors: *Chloropicrin, *Drinking water, *Water treatment, *Chlorination, *Water pollution sources, Potable water, Nitrites, Nitrogen compounds, Activated carbon, Trihalomethanes, Prechlorination.

Chloropicrin, a known toxic substance, has been found in several prechlorinated waters. Little is known about the conditions of its formation from different precursors and its evolution during the different steps of treatment. It is shown that chloropicrin may be present in surface water in the microgram per liter range when the total dissolved organic concentrations approach 10 mg/l. Precursors to the formation of chloropicrin include a variety of nitrogen containing organic compounds; however, nitrites, free chlorine, and trihalomethane precursors are most important. Although chloropicrin is effectively removed by granular activated carbon filtration, the simplest means of controlling its appearance is to abandon the practice of prechlorination. (Author's abstract)
W89-00635

HEAVY METAL REMOVAL BY DIFFERENT WATER TREATMENT PLANTS, IN RIO DE JANEIRO STATE, BRAZIL,
Universidade Federal do Rio de Janeiro (Brazil). Inst. de Biofisica.
J. Mauricio, P. Azcue, W. C. Pfeiffer, M. Fiszman, and O. Malm.
Environmental Technology Letters ETLEDB, Vol. 9, No. 5, p 429-436, May 1988. 1 fig, 6 tab, 8 ref.

Descriptors: *Heavy metals, *Water treatment, Rio de Janeiro, Copper, Nickel, Zinc, Chromium, Lead, Cadmium, Iron, Manganese, Aluminum, Suspended solids, Drinking water, Sludge, Brazil, Performace evaluation.

The concentrations of various heavy metals in drinking water were determined in the State of Rio de Janeiro, Brazil after conventional treatment. The efficiency of metal removal by different water treatment plants was also determined. Eight metals were studied: copper, nickel, zinc, chromium, lead, cadmium, iron, and manganese. Treatment was found not to affect the metal concentration in the dissolved phase, except for iron. Suspended particles are the critical compartment in heavy metal removal by the plants. The solids removed from the water column through flocculation-sedimentation constitute the sludge. The concentrations of copper, chromium, lead, iron, and aluminum in the available fraction of the sludge seem to reflect the concentrations of the same elements in the suspended particles of treated waters. This sludge is discharged into the surface water downstream. Total removal of copper, zinc, chromium, and cadmium from untreated water reached an average of 50%. For iron and aluminum, the average removal is close to 80%, while removals for nickel and lead average less than 50%. Manganese removal was 0% at some plants. It is concluded that the release of sludge can cause an impact in the river waters. (Doria-PTT)
W89-00647

COMPARISON OF BACTERIAL INDICATORS AND SAMPLING PROGRAMS FOR DRINKING WATER SYSTEMS,
Nancy-1 Univ. (France). Service d'Hydrologie et de Climatologie Therapeutiques.
For primary bibliographic entry see Field 5A.
W89-00733

RAPID DETECTION OF TOTAL AND FECAL COLIFORMS IN WATER BY ENZYMATIC HYDROLYSIS OF 4-METHYLUMBELLIFERONE-BETA-D-GALACTOSIDE,
Aquateam-Norwegian Water Technology Centre of Oslo (Norway).
For primary bibliographic entry see Field 5A.
W89-00734

DEGRADATION OF POLYCYCLIC AROMATIC HYDROCARBONS: III. REACTION PRODUCTS OF THE OZONOLYSIS OF FURTHER POLYCYCLIC AROMATIC HYDROCARBONS IN AQUEOUS SYSTEMS (ZUM ABBAU VON POLYCYCLISCHEN AROMATISCHEN KOHLENWASSERSTOFFEN: III. REAKTIONSPRODUKTE DER UMSETZUNG VON WEITEREN POLYCYCLISCHEN AROMATISCHEN KOHLENWASSERSTOFFEN IN WASSER MIT OZON),
Marburg Univ. (Germany, F.R.). Fachbereich Chemie.
W. Dreher, and H. Klamberg.
Fresenius' Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 331, No. 3/4, p 290-294, July 1988. 1 fig, 2 tab, 25 ref. English Summary.

Descriptors: *Water treatment, *Ozonation, *Aromatic compounds, *Hydrocarbons, *Chemical degradation, *Degradation products, Disinfection, Drinking water, Toxicity, Gas chromatography, Mass spectrometry, Ultrasonics.

The increasing use of ozone for oxidation and disinfection in drinking-water purification results in the breakdown of dissolved organic substances, such as toxic polycyclic aromatic compounds (PCAs) from fossil fuels. Eight PCAs, chosen as model substances, were submitted to ozonolysis in dilute aqueous systems. The products were derivatized, separated by capillary gas chromatography, and identified mass-spectrometrically. Aromatic carboxy acids and oxalic acid, derivatives of indane and fluorene, as well as sulfones and sulfonic acids occurred as reaction products. The degradation reactions of the PCAs were generally very fast and the composition of the reaction products was largely independent of the ozonation time. The influence of ultrasound on the reaction path was also investigated. (Author's abstract)
W89-00739

UPGRADING WATER SYSTEMS THROUGH PLANNING,
For primary bibliographic entry see Field 6B.
W89-00746

LONDON WATER RING MAIN,
Thames Water Authority, London (England).
W. J. Dickens, and I. H. Bensted.
Proceedings of the Institution of Civil Engineers PCIEAT, Vol. 84, No. 1, p 445-474, June 1988. 17 fig, 2 ref.

Descriptors: *England, *Water mains, *Construction, *London, *Water supply systems, Drinking water, Water treatment, Maintenance, Tunnels.

The development of the existing water supply system in London and the long-term strategy being adopted by Thames Water for trunk distribution of potable water from sources and treatment works into the local mains reticulation serving 5-25 million customers is described. A radical approach to the world-wide problem of the replacement of aging urban water supply systems is suggested. The long-term planning of London's water supply system presented a choice between orthodox mains extension together with replacement of the aging trunk main system or relief of the existing pumped system by a new gravity-fed system of tunnels constructed deep in the clay underlying the city. The new tunnels would have sufficient capacity to

meet increasing demand and to relieve those parts of the trunk main system which are progressively giving less satisfactory service. In terms of both economics and operational advantage, the construction of a gravity-fed tunnel ring, with cross-links as necessary, was selected as the preferred option. The estimated cost and benefits of the strategy are given and some of the technical and engineering feasibility work which has now been completed, including hydraulic analysis and simulations, development of control strategy, modes of operation and optimization are described. (Author's abstract)
W89-00840

PACKAGE WATER TREATMENT FACILITIES FOR REFUGEE COMMUNITIES,
N. J. D. Graham, and H. Hartung.
Proceedings of the Institution of Civil Engineers PCIEAT, Vol. 84, No. 1, p 605-610, June 1988. 6 fig, 8 ref.

Descriptors: *Water treatment facilities, *Developing countries, *Refugee camps, *Sand filters, Potable water, Somalia.

Package water supply systems have been developed by Oxfam and Imperial College for rapid deployment in emergency situations such as refugee settlements. A component of these is a water treatment unit for treating polluted surface waters by the process of slow sand filtration. Many such units have been deployed at refugee camps in Southern Somalia and have performed well. (Author's abstract)
W89-00841

PLANNING INDIANA'S WATER INFRASTRUCTURE FROM A COMPETITIVE PERSPECTIVE,
Purdue Univ., Lafayette, IN. School of Civil Engineering.
For primary bibliographic entry see Field 6B.
W89-00880

CHARACTERIZATION OF THE INTERACTION BETWEEN VIRUSES AND A SOLID POLYMERIC CONTACT DISINFECTANT,
Arizona Univ., Tucson. Dept. of Microbiology and Immunology.
R. B. Thurman, A. B. Margolin, J. P. Rockow, G. E. Janauer, and M. J. Costello.
Journal of Environmental Science and Health (A) JESEDU, Vol. 23, No. 5, p 405-423, 1988. 5 fig, 3 tab, 14 ref. EPA Contract CR-11911-01-0.

Descriptors: *Water treatment, *Wastewater treatment, *Viruses, *Disinfection, *Polymers, *Adsorption, *Resins, Human diseases, Viricides, Solubility.

The interaction between three different viruses and a sparingly soluble polymeric contact disinfectant was characterized under a variety of conditions. It was found that pH, turbidity, resin concentration, temperature and type of virus determined the degree of virus adsorption onto Resin 14 (a chloromethylated crosslinked polystyrene aminated with N,N-dimethyltetradecylbenzyl). Numerous methods were evaluated to recover the adsorbed viruses. However, only a small percentage of the total virus adsorbed could be recovered, as determined by infectivity and radioactively labeled virus. While viruses are effectively retained by the resin, there was no evidence that they were inactivated. The recovery of infectious particles after the elution of viruses, which had adsorbed onto Resin 14, suggests that viral inactivation on the resin surface is not significant. (Author's abstract)
W89-00884

MICROPOROUS FILTERS WITH OXIDIZING POWER FOR IRON AND MANGANESE REMOVAL FROM WATER,
CUNO, Meriden, CT.
K. Hou, T. J. Webster, and C. P. Gerba.
Journal of Environmental Science and Health (A) JESEDU, Vol. 23, No. 5, p 483-496, 1988. 4 tab, 10 ref.

Descriptors: *Water treatment, *Manganese, *Filters, *Heavy metals, *Iron, *Filtration, *Oxidation, *Chemical treatment, Adsorption, Magnesium peroxide, Domestic water, Solubility.

This report describes the development of a microporous filter carrying oxidizing power to convert the ionic species in water from soluble form, such as Fe(++) and Mn(++), to insoluble form, thus allowing for their continuous removal in one step. The filters were constructed with a cellulosic fiber network for immobilizing adsorbent particles carrying oxidizing power. The porosity of the filters was controlled by selecting the proper size of the binding fibers and the adsorbent. A number of substances were incorporated into the filter matrix and tested for their ability to remove soluble iron from water. Magnesium peroxide was found to be the most effective and was capable of removing significant quantities of iron from water at high flow rates. Removal is believed to take place by a combination of ferric ion adsorption, oxidation to insoluble ferrous hydroxide and filtration. Construction of filter cartridges demonstrated the effectiveness of the material for home water purification. (Author's abstract)
W89-00889

WATER SUPPLY AND SANITATION - CORNERSTONES OF THE WORLD HEALTH ORGANIZATION'S FORTY YEARS OF INTERNATIONAL HEALTH DEVELOPMENT,
World Health Organization, Geneva (Switzerland).
G. Watters.
Aqua AQUAAA, No. 2, p 60-66, 1988.

Descriptors: *Developing countries, *Water conveyance, *Sanitation, *Public health, *United Nations, *International agreements, World Health Organization, Planning, Water quality, Water distribution, Water treatment facilities.

In commemoration of World Health Day, which marks the fortieth anniversary of its founding, a history of the World Health Organization's commitment to quality water supply and sanitation is presented. Early approaches, including the programm introduced at the First World Health Assembly in June/July 1948, are discussed. It is clear that although the wording may have changed slightly over the years, the approaches identified by the Third World Health Assembly in 1950 were endorsed by the whole United Nations System in 1977 and formed the basis for the accelerated effort of the 1980s under the framework of the International Drinking Water Supply and Sanitation Decade. Progress made during the first half of the 1980s, new approaches to be taken in the second half of this decade, and strategies and efforts appropriate for the 1990s are discussed. (Miller-PTT)
W89-00917

USE OF NETWORK ANALYSIS TECHNIQUES IN THE DEVELOPMENT AND OPTIMIZATION OF A LARGE UK URBAN WATER DISTRIBUTION SYSTEM (L'EMPLOI DE TECHNIQUES),
Parkman Consulting Engineers, Liverpool (England).
G. J. Cleverly, and D. J. Algeo.
Aqua AQUAAA, No. 2, p 67-72, 1988. 4 fig, 6 tab.

Descriptors: *Water distribution, *Model studies, *Water conveyance, *England, *Network design, *Systems analysis, Water treatment facilites.

The modelling and calibration of Bolton, a large urban water distribution district for the UK's North West Water Authority, is described. The study demonstrated how the application of a dynamic network analysis program enabled a complex distribution system to be modelled satisfactorily and facilitated both the improved management of the existing system and the development of a new, more energy-efficient operating strategy. Use of the model allowed significant operating savings to be identified in one of the major supply zones of the Bolton Distribution network by a combination of maximizing the area supplied by gravity and reducing friction losses in major trunk mains. (Miller-PTT)
W89-00918

MODERN MANAGEMENT STANDARDS OF WATER NETWORK REGISTER (CRITERES MODERNES DE GESTION DU CADASTRE DES RESEAUX D'EAU),
Azienda Comunale Elettricita ed Acque, Rome (Italy).
G. Scalisi, and P. I. G. Borgianelli-Spina.
Aqua AQUAAA, No. 2, p 73-77, 1988. 3 fig. English summary.

Descriptors: *Data storage retrieval, *Water conveyance, *Information systems, *Drinking water, *Water distribution, *Data collections, *Graphical models, Graphical analysis, Network design.

Because it is underground, the drinking-water distribution network can be identified only by graphic documentation. Modern information engineering allows the filing of all graphic information in digital form rather than simply on paper. Traditional graphic representations allowed only limited information because increasing the graphic signs caused limits in data recording. The wide memory capacities in modern computer systems allow the recording of an unlimited amount of alphanumeric information, to be connected with every geographic point. Standards that must be used in order to manage the water networks registers are reported. (Author's abstract)
W89-00919

EFFECT OF UPGRADING A TUBEWELL WATER SUPPLY IN RURAL AREAS OF BANGLADESH,
Bangladesh Univ. of Engineering and Technology, Dacca. Dept. of Civil Engineering.
F. Ahmed, and P. G. Smith.
Aqua AQUAAA, No. 2, p 78-80, 1988. 3 fig, 2 tab, 2 ref.

Descriptors: *Water treatment, *Bangladesh, *Rural areas, *Well water, *Drinking water, *Domestic water, Groundwater, Water quality, Water supply, Developing countries.

The effect on water usage of improving water quality and generally upgrading a tubewell site in Bangladesh is discussed. Improvement measures include: (1) the installation of an iron removal plant for a ferruginous groundwater supply, (2) an increase in the size of the tubewell platform, and (3) an increase in the site privacy. Water use interviews revealed that chloride concentrations of up to 400 mg/l cause no objection but > 1000 mg/l results in very poor usage of the tubewell water. An average increase of just under 9 liters per capita per day water collection has been observed after installation of iron removal plants. An average increase of 7 liters per capita per day of tubewell water collection occurred after installation of a larger platform at the tubewell site. Water collection from tubewells located in open or public places is lower than from the tubewells located in unexposed places or from private tubewells. After construction of woven-mat fencing, the average increase in water consumption was about 3.5 liters per capita per day. (Miller-PTT)
W89-00920

OPTIMIZATION OF THE PRODUCTION AND PUMPING COSTS OF THE NICE WATER NETWORK (OPTIMISATION DE LA PRODUCTION ET DES POMPAGES SUR LE RESEAU D'EAU DE NICE),
Compagnie Generale des Eaux, Nice (France).
B. Jacheet, P. Gruget, and F. Damez.
Aqua AQUAAA, No. 2, p 85-92, 1988. 9 fig, 1 tab. English summary.

Descriptors: *Decision making, *Nice, *France, *Network design, *Model studies, *Pumping plants, *Water costs, Pumping, Injection, Costs, Production costs, Pumping costs, Water conveyance.

The Nice conurbation is supplied with water by a network pumped in six stages corresponding to

heights between 0 and 450 m above sea level. These networks communicate with each other by injection and re-pumping. The system is fed by two different water sources. At low level, the catchment field in the alluvial plain of the Var supplies water that is simply ozonized. Product costs in this case are mainly for the electric current required for the pumps and vary according to a timing schedule applied by the French electricity board. The Super-Rimiez waterworks that treats water from the Vesubie canal has a production cost depending on the consumption of reagents that, in turn, depends on the turbidity of the water. The production and pumping costs of this kind of system are determined by computerization. The main rules are to empty the water in the higher reservoirs during the day in order to reduce water from the catchment fields and to eliminate night injection of water from the higher levels to the lower systems. A simplified network model was devised by computer as an aid to decision making. This enables the day and night injection figures to be computed from two parameters: (1) the turbidity of Vesubie water, and (2) consumption on the network. The expected result will consist of doing a certain amount of hitherto day-time pumping during the night. The forecast annual saving would be more or less equal to the initial investment. (Author's abstract)
W89-00922

PETALING JAYA NON-REVENUE WATER CONTROL PROJECT SELANGOR, MALAYSIA,
Jabatan Bekalan Air Selangor, Shah Alam (Malaysia)
N. S. Loong, G. C. Peng, and C. W. P. Taylor.
Aqua AQUAAA, No. 2, p 93-98, 1988. 3 fig, 1 tab.

Descriptors: *Water lose, *Project planning, *Water conveyance, *Leakage, *Malaysia, Planning, Feasibility studies.

A 24-month long, two-phase feasibility study and scheme implementation project for the control of non-revenue water in a relatively modern, predominantly residential town in Peninsular Malaysia (population 250,000) is described. The primary objective of this project is to investigate the extent of non-revenue water prevailing in the project area and to identify and implement a non-revenue water reduction program for the Petaling Jaya area while striving to lower target figures for non-revenue water losses. The next objective is to recommend a policy for non-revenue water control in the other service areas in the state of Selangor. The project is divided into two phases: (1) Feasibility study and pilot scheme to investigate different methods of leakage control - 9 months, and (2) implementation of recommendations and training - 15 months. Details of the methodology adopted, the personnel and equipment deployed and Phase I recommendations are given along with the results obtained so far in the Phase II implementation stage. (Miller-PTT)
W89-00923

EMPIRICAL CORRELATION FOR ESTIMATING PRESSURE DROP ACROSS CLOGGED FILTERS,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Environmental Engineering.
S. Vigneswaran.
Aqua AQUAAA, No. 3, p 110-115, 1988. 12 fig, 1 tab, 13 ref. NSF Grant CPE 8309508.

Descriptors: *Water treatment facilities, *Clogging, *Correlation analysis, *Clays, *Filters, *Sand filters, Particulate matter, Pressure drop, Filtration, Correlation coefficient.

An empirical procedure which can be used to predict the increase in pressure drop across a filter bed as a function of the extent of deposition under fairly general conditions was developed. Standard correlation curves relate the increase in pressure drop over a filter bed segment to the specific deposit. With the correlation, it was possible to estimate the pressure drop rise associated with the filtration of kaolin clay suspensions in sand filters. Assuming that the kaolin clay particles may be considered as the model particulate matter present in water supply, the result can be used directly in water treatment design calculations. The arguments used in formulating the correlation, the type of experimental data on which the correlation is based and the accuracy of the correlation established are discussed. (Miller-PTT)
W89-00924

EPIDEMIOLOGICAL STUDY OF THE LEGIONELLA PNEUMOPHILA PRESENCE IN POTABLE WATER IN ALICANTE,
Municipal Waters of Alicante (Spain).
For primary bibliographic entry see Field 5A.
W89-00925

WATER CATCHMENT INSTALLATIONS HARMONIZED WITH ECOLOGICAL ASPECTS - AN EXAMPLE IN BERLIN (WEST),
Berliner Wasser-Betriebe Hohenzollerndamm (Germany, F.R.).
For primary bibliographic entry see Field 6B.
W89-00926

MODELING CONTAMINANT PROPAGATION IN DRINKING WATER DISTRIBUTION SYSTEMS,
Environmental Protection Agency, Cincinnati, OH. Water Engineering Research Lab.
R. M. Clark, W. M. Grayman, R. M. Males, and J. A. Coyle.
Aqua AQUAAA, No. 3, p 137-151, 1988. 18 fig, 2 tab, 13 ref.

Descriptors: *Path of pollutants, *Model studies, *Contamination, *Drinking water, *Water distribution, Water pollution, Temporal distribution, Spatial distribution.

The development of models that can be used to understand the temporal and spatial variation in contaminant levels that may be found in distribution systems is described. Model development was accomplished via a cooperative research program between the EPA and the North Penn Water Authority. The North Penn Water Authority serves 14,500 customers in 10 municipalities, with an average of 5 million gallons of water per day and is located north of Philadelphia, PA. Steady state, quasi-steady state, time of passage and dynamic models are described. A round the clock sampling program was conducted to calibrate the model. Based on the results of the research, it is clear that modeling of contaminant propagation can provide useful insights into system behavior. It was found that an indepth understanding of the behavior of the hydraulics of the system was essential to provide effective and representative modeling. It was also concluded that properly collected field data is important in developing, verifying and understanding predictive models. (Author's abstract)
W89-00929

STASOFT: A USER-FRIENDLY INTERACTIVE COMPUTER PROGRAM FOR SOFTENING AND STABILISATION OF MUNICIPAL WATERS,
Cape Town Univ. (South Africa). Dept. of Civil Engineering.
R. E. Loewenthal, G. A. Ekama, and G. V. R. Marais.
Water SA, Vol. 14, No. 3, p 159-162, July 1988. 7 ref.

Descriptors: *Water treatment, *Model studies, *Computer programs, *Municipal water, *Water softening, *Pumping.

The structure of a user-friendly, interactive computer program, called STASOFT, is described. The program has several applications: (1) to characterize a water, (2) to determine the chemical dosage to soften and/or stabilize the water for municipal use, (3) to evaluate the response of underground waters when pumped to the surface, and (4) to determine the characteristics of blends of two or more waters with difficult characteristics. The program can be executed only on IBM compatible personal computers and is easy to master. (Author's abstract)
W89-00935

TREATMENT OF HERBICIDES IN GROUND WATER,
DETOX, Inc., Dayton, OH.
E. K. Nyer.
Ground Water Monitoring Review GWMRDU, Vol. 8, No. 3, p 54-59, Summer 1988. 1 fig.

Descriptors: *Water treatment, *Herbicides, *Pesticides, *Aquifers, Hydrogen peroxide, Alachlor, Atrazine, Butylate, Metolachlor, Adsorption, Ozone, Ultraviolet radiation.

The general removal and destruction mechanisms for a variety of herbicides from a surficial aquifer in Wisconsin are discussed. Contaminants to be removed include Alachlor (made by Monsanto under the trade name 'Lasso'), Atrazine (made by Ciba-Geigi), Butylate (also made by Ciba-Geigi), and Metolachlor (made by ICI America). Advantages and disadvantages of each of the three possible remediation technologies as well as a cost comparison are presented. These technologies include: (1) carbon adsorption, (2) oxidation with ultraviolet light and hydrogen peroxide, and (3) oxidation with ultraviolet light and ozone. The most expensive treatment in terms of both capital and operating costs is the ultraviolet/ozone treatment. There is little difference in costs between the carbon adsorption and ultraviolet/hydrogen peroxide system. (Miller-PTT)
W89-00938

EFFECTS OF DISCHARGE FLUCTUATION AND THE ADDITION OF FINE SEDIMENT ON STREAM FISH AND MACROINVERTEBRATES BELOW A WATER-FILTRATION FACILITY,
California Univ., Berkeley. Dept. of Forestry and Resources Management.
For primary bibliographic entry see Field 5C.
W89-01061

RO DESALINATION IN NORTHWEST CHINA,
Lanzhou Inst. of Membrane Science and Tech. (China).
For primary bibliographic entry see Field 3A.
W89-01065

PRELIMINARY PLAN FOR MEMBRANE DESALINATION IN CHINA,
National Bureau of Oceanography, Hangzhau (China). Second Inst. of Oceanography.
For primary bibliographic entry see Field 3A.
W89-01066

FILTRATION TECHNOLOGIES FOR WATER TREATMENT,
CWC-HDR, Inc., Cameron Park, CA.
S. P. Hansen.
Water/Engineering and Management WENMD2, Vol. 135, No. 8, p 16-18, 22, 24, August 1988. 5 fig, 3 tab, 4 ref.

Descriptors: *Water treatment facilities, *Water treatment, *Filtration, Sand filters, Direct filtration, Package plants, Diatomaceous earth, Giardia, Turbidity, Ultrafiltration, Membrane processes, Regulations, Surface Water Treatment Rule, Surface water, Coagulation, Viruses, Microorganisms, Clarifiers.

Several filtration technologies are designated as Most Applicable Technologies for treatment of surface water supplies under the EPA Surface Water Treatment Rule. (1) Conventional treatment, most widely used, includes pretreatment with chemical coagulation, rapid mixing, flocculation and sedimentation followed by filtration. (2) Direct filtration involves only filters, often pressure units, preceded by chemical coagulation and mixing. Raw water must be of seasonally uniform quality with turbidities less than 5 NTU. (3) Diatomaceous earth filtration (also known as precoat or

diatomite filtration) is applicable to direct treatment of surface waters with relatively low turbidity. Problems are inherent in maintaining a perfect 1/8-in thick film during the process. However, it is effective in removing Giardia cysts. (4) Slow-sand filtration is commonly used in small community systems because of simplicity of operation. The filtration rates are 50 to 100 times slower than direct filtration. (5) Package plants are factory-assembled units typically consisting of chemical coagulation, flocculation, settling, and filtration. A wide range of capacities and designs are available. A new concept is the adsorption clarifier package plant, which utilizes an upflow filter of low-density plastic bead media following by a mixed-media filter for final polishing. (6) Other filtration technologies, considered newly emerging, are membrane filtration (ultrafiltration) and cartridge systems. Performance data for removal of microbes, viruses, Giardia lamblia cysts, and turbidity are given. (Cassar-PTT)
W89-01099

SELECTING A CONTRACT OPERATOR FOR YOUR WATER OR WASTEWATER FACILITY,
Professional Services Group, Inc., Houston, TX.
M. M. Stump.
Water/Engineering and Management WENMD2, Vol. 135, No. 8, p 26-28, August 1988.

Descriptors: *Water treatment, *Wastewater treatment, *Operating policies, *Contracts, Maintenance, Performance evaluation, Management planning, Regulations.

A growing number of communities are running their water and wastewater treatment plants under contract operations agreements. Under this arrangement the municipality owns the facilities, and a private firm hires employees and assumes responsibility for complete operation and quality control. Conditions which have made contract operation more attractive to a muncipality are the increasing stringent standards for operating wastewater plants, inadequately trained employees, lack of available personnel with required skills, and rising operating costs. Selection of a contractor involves investigation of the contractors' qualifications, preparation of a request for proposal, evaluation of the proposals after submission by the contractors, final selection of a firm (possibly with a backup), and development of a suitable contract for operation. After plant operation has been assumed by the private contractor, the municipality must monitor the performance of the contractor, usually by daily contact between the utility manager and the contractor. Employees are usually chosen from the present group of municipal workers. The fear of losing control of the facility can be eased by careful choice of a contractor and regular reporting mechanisms. (Cassar-PTT)
W89-01100

VALVES FOR CONTROLLING PRESSURE, FLOW AND LEVEL,
Watts Regulator Co., North Andover, MA.
J. P. Hopkins.
Water/Engineering and Management WENMD2, Vol. 135, No. 8, p 42-44, August 1988. 9 fig.

Descriptors: *Water distribution, *Valves, *Water pressure, *Flow control, *Water level, Control systems, Automation, Sensors.

Automatic control valves are used for control of pressure, flow, and level in water distribution systems. For pressure control the following types of valves are available: pressure reducing valve, sustaining or back pressure control valve, and relief valve. Flow control is accomplished in gravity systems with a hydraulically operated valve equipped with a pilot control system that responds to a differential producing device such as an orifice plate. Valves used for flow control in pumped systems are differential relief valves and pressure sustaining or back pressure valves. Float type controls, either mechanical or hydraulic, are the most common level controls. Other methods are electric probes in a tank and floatless controls (also known as altitude valves). In addition to the single-function valves described above, multiple-function valves are available. An example is a pressure reducing/pressure sustaining valve with a check feature and a solenoid override to open or close the valve from a remote location in response to signals from electrical probes or pressure switches in the system. (Cassar-PTT)
W89-01102

MAKING THE RIGHT MOVES IN SCADA SELECTION,
HSQ Technology, Inc., San Francisco, CA.
D. J. Arndt.
Water/Engineering and Management WENMD2, Vol. 135, No. 8, p 56-58, 60, 62, 65, August 1988. 5 fig, 6 ref.

Descriptors: *SCADA systems, *Water treatment, *Wastewater treatment, *Control systems, *Automation, Data acquisition, Computers, Supervisory Control and Data Acquisition systems, Data processing, Data transmission, Design criteria.

Supervisory Control and Data Acquisition (SCADA) systems, properly designed and executed, should benefit the owner of a water system for more than a decade. Goals of a computer system are to make the information flow more productively and provide the operator with a means to better understand the process. The minimum configuration of a SCADA system includes a central computer, an interactive operator terminal, a printer or two, site-installed data acquisition units, and the means for the central computer to communicate with all of these entities. These components may be combined to suit the system needs. Factors in system design are how the system is to be used, who is going to use it, what is the size of the initial system, and what are the future expansion requirements. Points to be considered in the selection of a SCADA system are the hardware capacity, software suitable for the present needs and for future expansion, ease of man-to-machine interface, good documentation of system and programs, guaranteed training by the manufacturer, reliability of the supplier, service availability, warranty, and the use of consulting firms for system selection. A chart is presented showing the appropriate combination of computers and terminals and their sizes for seven sizes of systems from a small system with 12 remote telemetry units with 1 user to a super system with up to 500 remote telemetry units and 4 users at 3 locations. (Cassar-PTT)
W89-01103

RADIONUCLIDES IN DRINKING WATER,
Maine Univ., Orono. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-01104

OCCURRENCE OF RADON IN WELL SUPPLIES,
American Water Works Service Co., Voorhees, NJ. System Water Quality Dept.
For primary bibliographic entry see Field 5B.
W89-01105

DISPOSAL OF RADIUM REMOVED FROM DRINKING WATER,
Wisconsin Dept. of Natural Resources, Madison.
For primary bibliographic entry see Field 5E.
W89-01106

OPERATING A SMALL FULL-SCALE ION EXCHANGE SYSTEM FOR URANIUM REMOVAL,
Arber (Richard P.) Associates, Inc., Denver, CO.
R. T. Jelinek, and T. J. Sorg.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 7, p 79-83, July 1988. 1 fig, 8 tab, 9 ref. U.S. EPA Order 7C7639NNSE.

Descriptors: *Well waters, *Water treatment, *Sludge disposal, *Uranium radioisotopes, *Radioisotopes, *Ion exchange, Radon, Wells, Groundwater.

The design and operation of a small full-scale anion exchange system used to remove uranium from well water near Denver, Colorado, are described. The treatment system consists of two spiral-wound cartridge prefilters in parallel, a two-tank commercial water softener system arranged in series, a brine tank to batch regenerant, and facilities to store or transfer spent regenerant. Large vented treated-water storage tanks provide sufficient detention time and water-air interface for release of radon gas before use. The raw water processed in this system does not have high radon levels. Ultimate disposal of spent ion exchange resin regenerants and rinse waters is by hauling and discharge into a local wastewater treatment facility. Regeneration is done about twice a year, since the system serves a school. Gamma radiation buildup within the system does not appear to be a health concern. (Cassar-PTT)
W89-01107

EVALUATING VARIOUS ADSORBENTS AND MEMBRANES FOR REMOVING RADIUM FROM GROUNDWATER,
Houston Univ., TX. Dept. of Civil and Environmental Engineering.
D. Clifford, W. Vijjeswarapu, and S. Subramonian.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 7, p 94-104, July 1988. 7 fig, 10 tab, 35 ref. U.S. EPA and University of Houston Cooperative Agreement CR-813148.

Descriptors: *Water treatment, *Radium, *Membrane processes, *Adsorption, *Reverse osmosis, Dissolved solids, Radium-selective complexer, Radon, Alumina, Sludge disposal, Ion exchange, Groundwater pollution, Radioisotopes, Performance evaluation, Cost analysis.

Field studies were conducted in Lemont, Illinois, to evaluate adsorbents and reverse osmosis membranes for removing radium from groundwater. A radium-selective complexer and barium-sulfate-loaded alumina appeared to have the best potential for low-cost adsorption of radium from raw water or ion exchange brines, provided that the problem of the ultimate disposal of spent media can be solved. A new, low-pressure (70 psig) reverse osmosis module achieved radium and total dissolved solids rejections of 91% and 87%, respectively. Central treatment with standard or low-pressure reverse osmosis modules would be effective for radium removal, but expensive and unnecessary if total dissolved solids reduction is not also required. Point-of-use treatment using reverse osmosis is effective for removing radium and may be cost effective for very small communities. (Author's abstract)
W89-01109

METHODS FOR REMOVING URANIUM FROM DRINKING WATER,
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
T. J. Sorg.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 7, p 105-111, July 1988. 8 fig, 6 tab, 15 ref.

Descriptors: *Water treatment, *Uranium, Drinking water, Radon, Coagulation, Filtration, Lime, Ion exchange, Alumina, Activated carbon, Adsorption, Reverse osmosis, Hydrogen ion concentration, Performance evaluation, Water softening.

Treatment methods for removing uranium from drinking water are reviewed. Percent removals of uranium were as follows: iron coagulation, 80-95 at pH 6 and 10; alum coagulation, 90-95 at pH 10 and 80-85 at pH 6; lime softening, 99 at pH 10.6 plus Mg ion from natural or added sources; cation exchange, 80-85; cation exchange in H+ form, 90-95 at pH 3.5; cation exchange in Ca++ form, 70 at pH 4; cation exchange in Na+ form, 70-85 at pH 7 and above; anion exchange, 99 at 10,000 to 50,000 bed volumes; activated alumina, 99 at 1500 to 2000 bed volumes; granular activated carbon, 90+ (limited capacity); and reverse osmosis, 99. Although cation exchange and granular activated carbon can remove uranium effectively, their use in drinking water treatment is not considered practical. (Cassar-PTT)

W89-01110

ROLE OF THE STATES IN SOLVING THE SMALL SYSTEM DILEMMA,
Miller (Wade) Associates, Inc., Arlington, VA.
For primary bibliographic entry see Field 6E.
W89-01111

SDWA AMENDMENTS: SMALL COMMUNITY COMPLIANCE,
Black and Veatch, Kansas City, MO.
For primary bibliographic entry see Field 6E.
W89-01112

FINANCING STRATEGIES FOR SMALL SYSTEMS,
Nuveen (John) and Co., Inc. Chicago, IL.
B. R. Sagraves, J. H. Peterson, and P. C. Williams.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 8, p 40-43, August 1988. 3 tab.

Descriptors: *Water treatment, *Financing, *Small water systems, *Safe Drinking Water Act, Drinking water, Costs, Capital costs, Management planning, Regulations.

The financing demands and economic burdens of complying with the requirements of the 1986 amendments to the Safe Drinking Water Act will be the greatest and most difficult to overcome for water systems serving populations of fewer than 10,000 people. The unit cost of compliance will be dramatically higher for small systems than that for larger systems, and small systems will have to deal with rate shock, financing plans of marginal feasibility, and limited access to capital markets. Creative new measures must be developed to furnish the needed capital to small water utilities. Models for these efforts include local initiatives in the form of mergers and joint action and state initiatives that include pooling of debt financing, credit support, and outright subsidies. (Author's abstract)
W89-01113

AWWA SMALL SYSTEMS PROGRAM,
American Water Works Association, Denver, CO.
M. A. Scharfenaker.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 8, p 44-45, 47, August 1988.

Descriptors: *Water treatment, *Small water systems, *Technology transfer, *Education, Regulations, Safe Drinking Water Act, Standards, Drinking water, Costs, Financing, American Water Works Association Small Systems Program.

To better help small water systems comply with increasingly stringent drinking water regulations, the American Water Works Association has established a Small Systems Program as a component of the Technical and Professional Activities Department. All association efforts to assist small systems have been consolidated with the program, the primary objective of which is outreach education through information dissemination and technical assistance at the section level, in cooperation with state regulatory agencies and other organizations assisting small systems. Recent infusions of outside funds have made the fledgling Small Systems Program into a $300,000 operation. (Author's abstract)
W89-01114

RURAL COMMUNITY ASSISTANCE PROGRAM,
Rural Community Assistance Corp., Sacramento, CA.
W. French, and E. Ytell.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 8, p 48-51, August 1988.

Descriptors: *Technology transfer, *Training, *Water treatment, *Rural areas, Small water systems, Regulations, Safe Drinking Water Act, State jurisdiction, Water quality, Standards, Drinking water, Costs, Financing, Training, Rural Community Assistance Program, Governmental interrelations.

The Rural Community Assistance Program comprises six regional agencies whose goal is to develop the capability of rural community officials to solve their own local water and wastewater problems. Funded for more than nine years by various federal, state, and private sources, the program agencies offer region-specific technical assistance and training and work to improve federal and state government response to the needs of rural communities. (Author's abstract)
W89-01115

SOURCE PROTECTION AND THE SMALL UTILITY,
Chautauqua County Dept. of Health, Mayville, NY. Div. of Environmental Health Services.
For primary bibliographic entry see Field 5G.
W89-01116

DESIGN CONSIDERATIONS FOR PACKAGE WATER TREATMENT SYSTEMS,
Process Applications, Inc., Fort Collins, CO.
L. D. DeMers, B. D. Hanzon, F. L. Glick, and R. M. Schultz.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 8, p 58-61, August 1988. 2 fig, 2 tab.

Descriptors: *Water treatment facilities, *Water treatment, Performance evaluation, Package water systems, Crested Butte Water and Sanitary District, Colorado, Recreation facilities, Water supply.

The Crested Butte Water and Sanitary District (Colorado) chose a package water treatment system to replace its existing system, which needed upgrading. It was especially important to provide a high quality product because any outbreak of waterborne disease could have dramatic economic repercussions in this mountain resort community. The package plant selected provided a traditional treatment train of flocculation sedimentation, and filtration. It has proved easy to operate and has allowed the district to efficiently use its two water sources, springs on the mountain and the East River. It was possible to install the system during the 1985 construction season with a few finishing touches the following summer. (Cassar-PTT)
W89-01117

NEW REGULATIONS: A CHALLENGE FOR SMALL SYSTEMS,
Brown and Caldwell, Irvine, CA.
R. G. Sykes, and R. N. Doty.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 8, p 62-64, August 1988. 1 fig, 1 tab.

Descriptors: *Water treatment, *Small water systems, *Regulations, *Safe Drinking Water Act, State jurisdiction, Water quality, Standards, Drinking water, Costs, Financing, Mountain Water Company, Montana, Vandenberg Village, Santa Paula Water Works, California, Case studies, Trihalomethanes.

Three small utilities using groundwater as the sole source of supply are shown as examples of the effects of the 1986 amendments to the Safe Drinking Water Act. The Mountain Water Company, Missoula, Montana, faces the possibility of one of its sources (a subsurface spring infiltration gallery) being redesignated as a surface water source rather than as a groundwater source. This would require monitoring for many more drinking water contaminants and possible installation of filtration and disinfection equipment. Other options in this situation are modifications to prevent surface contamination or abandonment of the infiltration gallery. A second type of problem is faced by the Vandenberg Village, California, water utility--meeting lower maximum contaminant levels for trihalomethanes. This system removes iron and manganese, producing a chlorine residual. The concentration of trihalomethanes could be minimized by limiting retention time in storage tanks and altering operations. The Santa Paula, (California) Water Works exemplifies a third situation: the probability that the water quality would meet the more stringent standards and no changes would be required. (Cassar-PTT)
W89-01118

OZONE-INDUCED PARTICLE DESTABILIZATION,
Stevens Inst. of Tech., Hoboken, NJ. Dept. of Civil and Ocean Engineering.
D. Grasso, and W. J. Weber.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 8, p 73-81, August 1988. 20 fig, 3 tab, 73 ref.

Descriptors: *Water treatment, *Disinfection, *Ozonation, *Organic matter, *Particulate matter, Dissolved organic carbon, Humic acids, Bentonite, Turbidity, Huron River, Mokcular structure, Polymerization.

Commercial humic acid preparations respond differently to ozonation when compared with natural dissolved organic matter. Ozonation decreases the relative polarity of the natural Huron River water dissolved organic matter and increases that of humic acid. Ozonation produces apparent shifts toward higher apparent molecular weight species in the Huron River water systems and toward lower apparent molecular weight species in the humic acid systems. The dissolved organic matter in the Huron River water is primarily aliphatic, whereas the humic acid appears to include a substantial amount of methyl aromatics. Ozonation may cleave aromatic rings in the humic acid system and create longer chain aliphatics in the Huron River water. The nature and chemistry of the particles in aquatic systems also play important roles in ozone's impact on their relative stability. Polymerization of metastable organics may be the primary mechanism responsible for ozone-induced particle destabilization in the Huron River water-bentonite system. (Cassar-PTT)
W89-01120

REVIEW OF THE USE OF XAD RESINS TO CONCENTRATE ORGANIC COMPOUNDS IN WATER,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W89-01215

GRAVIMETRIC MEASUREMENT OF ADSORPTION PARAMETERS IN WATER SYSTEMS WITH A QUARTZ SPRING BALANCE,
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
For primary bibliographic entry see Field 5A.
W89-01216

FACTORS AFFECTING COAGULATION WITH ALUMINUM SULFATE: I. PARTICLE FORMATION AND GROWTH,
Arizona Univ., Tucson. Dept. of Civil Engineering.
C.-J. Kuo, G. L. Amy, and C. W. Bryant.
Water Research WATRAG, Vol. 22, No. 7, p 853-862, July 1988. 6 tab, 37 ref.

Descriptors: *Water treatment, *Chemical coagulation, *Aluminum sulfate, *Coagulation, *Particle formation, *Particle growth, Water quality, Hydrogen ion concentration, Turbidity, Ozonation, Flocculation, Experimental design, Dissolved solids, Filtration.

The effects of several important water-quality and water-treatment variables on particle formation and growth during chemical coagulation were studied. Experimental variables included initial pH, initial turbidity, aluminum sulfate dose, preozonation dose, and flocculation time. An orthogonal experimental design was employed with statistical analysis of data by Duncan's Multiple-Range Test. The variables investigated proved to be capable of imparting, individually or collectively, statistically-significant effects on particle formation and growth. Differences in dissolved organic matter also affected particle growth. Volume average diameter and total particle number proved to be parameters more sensitive than turbidity in moni-

toring particle-related phenomena. For the conditions studied during this research, an alum dose of 25 mg/l, without preozonation, and with a flocculation period of 20 min provided effective particle growth, adequate for removal by a subsequent granular-media filtration process. Particle growth during coagulation was a necessary prerequisite for the effective use of subsequent solid/liquid separation processes. (See also W89-01122) (Author's abstract)
W89-01221

FACTORS AFFECTING COAGULATION WITH ALUMINUM SULFATE: II. DISSOLVED ORGANIC MATTER REMOVAL,
Arizona Univ., Tucson. Dept. of Civil Engineering.
C.-J. Kuo, and G. L. Amy.
Water Research WATRAG, Vol. 22, No. 7, p 863-872, July 1988. 4 fig, 8 tab, 28 ref.

Descriptors: *Water treatment, *Chemical coagulation, *Aluminum sulfate, *Coagulation, *Dissolved solids, Water quality, Hydrogen ion concentration, Turbidity, Ozonation, Flocculation, Experimental design, Organic carbon, Alum, Humic acids.

The effects of initial water-quality conditions and water-treatment variables on the removal of dissolved organic matter (DOM) during coagulation were studied. Initial pH, initial turbidity, aluminum dose, preozonation dose, and flocculation time were studied as experimental variables. An orthogonal experimental design was employed with statistical analysis of data by Duncan's Multiple-Range Test. The removal of DOM was studied by measuring nonpurgeable organic carbon and uv absorbance. The dominant factor affecting the removal of DOM was alum dose. Effective DOM removal was observed at pH 5.5 in the presence of a moderate amount of turbidity. Preozonation did not clearly affect DOM removal, while the provision of a flocculation period may not necessarily be required for effective DOM removal. Conditions conducive to effective DOM removal were generally similar to those effective in promoting particle formation and growth. Important characteristics of the DOM such as molecular weight and humic substances content were also found to influence its removal. (See also W89-01121) (Shidler-PTT)
W89-01222

MECHANISM OF INACTIVATION OF TOBACCO MOSAIC VIRUS WITH OZONE,
Government Industrial Development Lab., Sapporo (Japan).
N. Shinriki, K. Ishizaki, T. Yoshizaki, K. Miura, and T. Ueda.
Water Research WATRAG, Vol. 22, No. 7, p 933-938, July 1988. 6 fig, 28 ref.

Descriptors: *Water treatment, *Wastewater treatment, *Ozonation, *Viruses, *Plant viruses, Disinfection, Phosphates, RNA, Tritium, Proteins, Correlation analysis.

The use of ozone for disinfection and inactivation of viruses is attracting considerable attention; it is already used for water and wastewater treatment in Europe. Accordingly, the inactivation by ozone of tobacco mosaic virus (TMV) in a phosphate buffer (pH 6.9) was studied. It was previously reported that the damage to naked TMV RNA occurred at the guanine moiety of the RNA; this paper describes experiments which clarified the inactivation mode by using tritium-labeled TMV (TMV*) prepared by the reconstitution of tritium-labeled TMV RNA (RNA*) and the coat protein of TMV. It was found that the amount of extracted TMV RNA* from ozone-treated TMV* decreased with the advance of ozonization, and that there was good correlation between the loss of infectivity and the decrease of recovery of TMV RNA*. When TMV lost its infectivity due to ozone, tryptophan and tyrosine of the coat protein were also degraded by the ozone. Polyacrylamide-gel electrophoretic analysis of the substance produced during ozonization showed that the coat protein subunits were aggregated with each other and cross-linked with TMV RNA*. From these results, it was concluded that loss of uncoating ability is the major cause of the degradation of TMV infectivity by ozone. (Author's abstract)
W89-01229

NITRATE REMOVAL FROM WATER SUPPLIES USING BIOLOGICAL DENITRIFICATION,
Nebraska Univ.-Lincoln. Dept. of Civil Engineering.
M. F. Dahab, and Y. W. Lee.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 9, p 1670-1674, September 1988. 5 fig, 2 tab, 20 ref.

Descriptors: *Water treatment, *Nitrates, *Nitrogen removal, *Biological treatment, *Denitrification, Water supply, Contamination, Turbidity, Suspended solids, Pretreatment of water.

The potential of using bio-denitrification for removing nitrates from contaminated water supplies using static-bed upflow reactors was examined. The reactors were operated for 10 months with a feed concentration of 100 mg nitrate-N/L. This treatment resulted in near-total removal of nitrate at a C/N ratio of 1.5. They also imparted turbidity and suspended solids to the effluent; thus, bio-denitrification can only be used as a pretreatment step in a water-purification system. (Author's abstract)
W89-01237

ANALYTICAL SIMULATION OF WATER SYSTEM CAPACITY RELIABILITY: 1. MODIFIED FREQUENCY-DURATION ANALYSIS,
Case Western Reserve Univ., Cleveland, OH. Dept. of Systems Engineering.
B. F. Hobbs, and G. K. Beim.
Water Resources Research WRERAO, Vol. 24, No. 9, p 1431-1444, September 1988. 8 fig, 41 ref, append. NSF Grant ECE 85-52524.

Descriptors: *Water supply, *Management planning, *Simulation analysis, *Frequency analysis, *Water demand, Water storage, Pumps, Water treatment facilities, Capacity, Aqueducts, Estimation.

The computation of the unavailability and expected unserved demand of a water-supply system having random demand, post-treatment water storage, and unreliable capacity components was investigated. Examples of such components included pumps, treatment plants, and aqueducts. Modified frequency/duration analysis estimated these reliability statistics by, first, calculating how often demand exceeded available capacity and, second comparing the amount of water in storage with how long such capacity deficits lasted. This approach built upon frequency/duration methods developed by the power industry for analyzing generation-capacity deficits. Three versions of the frequency/duration approach are presented. Two yield bounds to system unavailability and unserved demand and the third gives an estimate of their true values between those bounds. (See also W89-01240) (Author's abstract)
W89-01240

ANALYTICAL SIMULATION OF WATER SYSTEM CAPACITY RELIABILITY: 2. A MARKOV CHAIN APPROACH AND VERIFICATION OF THE MODELS,
Case Western Reserve Univ., Cleveland, OH. Dept. of Systems Engineering.
G. K. Beim, and B. F. Hobbs.
Water Resources Research WRERAO, Vol. 24, No. 9, p 1445-1458, September 1988. 4 fig, 3 tab, 26 ref, append. NSF Grant ECE 85-52524.

Descriptors: *Water supply, *Management planning, *Simulation analysis, *Capacity, *Markov process, *Water demand, Model testing, Streamflow, Water storage, Probabilistic process, Frequency analysis, Monte Carlo method, Estimation, Networks, Reservoirs.

A reliability model for water-supply systems represents demand changes, failures and repairs of capacity components, and streamflows as independent Markov chains. Finished (post-treatment) water storage was simulated using an operating policy that depended on the system state. Reliability statistics, including system unavailability, expected unserved demand, and the frequency and duration of failures, were obtained from the transition probabilities and resulting steady-state probabilities. Both the Markov model and another analytical simulation approach, the modified frequency/duration (F/D) method, were applied to an actual water-supply system. Their results were compared to those of a more realistic Monte-Carlo simulation in order to verify that analytical simulation yielded useful estimates of reliability indices. The modified F/D model based on an exponential distribution of capacity-deficit durations yielded adequate estimates of system unavailability and expected unserved demand, compared to Monte-Carlo simulation. So, too, did the Markov model; in addition, the Markov technique gave good estimates of mean failure frequency and duration. If it is desired to analyze systems with multiple demand points, complex networks, and a large amount of storage, Monte-Carlo simulation is to be preferred. Two procedures for interfacing models of capacity reliability with simulation models of large reservoirs are proposed: (1) to assume that the supply capacity is the outflow of the reservoir, based upon an operating policy chosen without consideration of outages of other system components or random variations in demand; or (2) to study capacity reliability only during the periods for which reservoir releases are adequate to meet demands, and to assume that during times of insufficient releases the capacity of other components is no less than the reservoir release. (See also W89-01239) (Shidler-PTT)
W89-01241

WATER SUPPLY YIELDS POWER,
O'Brien and Gere Engineers, Inc., Syracuse, NY.
For primary bibliographic entry see Field 8C.
W89-01254

5G. Water Quality Control

SCIENTIFIC CONCEPTS AND METHODOLOGIES PERTINENT TO LAKE RESEARCH AND LAKE RESTORATION,
National Water Research Inst., Burlington (Ontario).
For primary bibliographic entry see Field 2H.
W89-00013

BACKGROUND ASPECTS OF LAKE RESTORATION: WATER BALANCE, HEAVY METAL CONTENT, PHOSPHORUS HOMEOSTASIS,
Northwestern Univ., Evanston, IL. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2H.
W89-00014

LAKE RESTORATION: WHY OXYGENATION AND ARTIFICIAL MIXING CANNOT SUBSTITUTE FOR A DECREASE IN THE EXTERNAL PHOSPHORUS LOADING,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
R. Gachter.
Schweizerische Zeitschrift fuer Hydrologie SZHYA6, Vol. 49, No. 2, p 170-185, August 1987. 13 fig, 3 tab, 13 ref.

Descriptors: *Limnology, *Lake restoration, *Eutrophication, *Eutrophic lakes, *Phosphorus, *Aeration, Remedies, Baldegg Lake, Sempach Lake, Oxygenation, Hypolimnion, Switzerland.

Data obtained from Lakes Baldegg and Sempach, two artificially mixed and oxygenated lakes, show that it is technically possible to significantly improve redox conditions, even in large eutrophic lakes. This paper discusses (1) why the well-known release of phosphorus from anoxic sediments does not necessarily result from an abiotic reduction of phosphorus containing iron compounds; (2) why

net phosphorus retention by sediments is not simply linearly related to the phosphorus content of a lake; and (3) why artificial oxygenation of a previously anoxic hypolimnion does not permanently increase phosphorus retention capacity of lake sediments. It is concluded that improvement of hypolimnic redox conditions by lake internal measures such as aeration or oxygenation may accelerate the rate of recovery induced by a reduction of the external phosphorus loading, but that oxygenation per se will hardly be able to cause a reduction of trophic state. (Author's abstract)
W89-00015

INTERNAL ELEMENTAL CYCLES AFFECTING THE LONG-TERM ALKALINITY STATUS OF LAKES: IMPLICATIONS FOR LAKE RESTORATION,
Freshwater Biological Association, Windermere (England).
W. Davison.
Schweizerische Zeitschrift fuer Hydrologie SZHYA6, Vol. 49, No. 2, p 186-201, August 1987. 3 fig, 3 tab, 23 ref.

Descriptors: *Lake restoration, *Chemical properties, *Alkalinity, *Limnology, *Acid lakes, *Acidity, *Carbon cycle, Redox reactions, Lake sediments, Atmosphere, Organic matter, Nutrients, Ecosystems, Cycling nutrients, Homeostasis, Eutrophication.

Although the major processes affecting the acid-base balance of a lake are directly linked to reactions involving nitrogen and sulfur, they also are influenced by the carbon cycle which is regulated by the supply of phosphorus. Changes in the long-term alkalinity of a lake are brought about by redox reactions in solution and through interactions with the atmosphere and sediments. Adding organic material or nutrients may help to restore acidified lakes, by generating base and by the increased carbon turnover creating a self-regulating ecosystem which is resistant to change. (Author's abstract)
W89-00016

STRATEGIES OF LAKE SANITATION,
Wahnbachtalsperrenverband, Siegburg (Germany, F.R.).
H. Bernhardt.
Schweizerische Zeitschrift fuer Hydrologie SZHYA6, Vol. 49, No. 2, p 202-219, August 1987. 6 fig, 3 tab, 39 ref.

Descriptors: *Lake restoration, *Water pollution control, *Management planning, *Phosphorus compounds, *Eutrophic lakes, Eutrophication, Limiting nutrients.

Lake sanitation measures must be planned so that the trophic state that is needed for the lake to fulfill its designated purpose can be achieved with a sufficient degree of certainty. This is obtainable solely by limiting the influx of phosphorus compounds. The influencing factors and a knowledge of the local conditions that must be considered during planning are described and discussed. The limits and effectiveness of technical and administrative single and joint control measures are presented with regard to the source of the phosphorus compounds. (Author's abstract)
W89-00017

RESPONSE OF PHYTOPLANKTON COMMUNITIES TO CHANGING LAKE ENVIRONMENTS,
Freshwater Biological Association, Windermere (England).
For primary bibliographic entry see Field 2H.
W89-00018

FOOD WEB MANIPULATION WITHOUT NUTRIENT CONTROL: A USEFUL STRATEGY IN LAKE RESTORATION,
Technische Univ., Dresden (German D.R.). Sektion Wasserwesen.
J. Benndorf.
Schweizerische Zeitschrift fuer Hydrologie SZHYA6, Vol. 49, No. 2, p 237-248, August 1987. 7 fig, 1 tab, 32 ref.

Descriptors: *Limnology, *Lake restoration, *Food chains, *Biomanipulation, *Eutrophic lakes, *Water quality control, Zooplankton, Phytoplankton, Nutrients, Phosphorus, Eutrophication, Light penetration, Turbidity.

The results of long-term, full-scale experiments in biomanipulation (in the closer sense of top-down control of the food web) in water bodies having extremely different phosphorus loads reveal that there is a close connection between the efficiency of food web manipulation and the nutrient situation in the particular water body. Top-down control provides a high probability of improving water quality with respect to Secchi depth and algal biomass only if it is connected with a decrease in the in-lake phosphorus. If that decrease in phosphorus is not achieved for different reasons, the high probability of an efficient top-down control is limited to zooplankton and to structural changes in the phytoplankton. A lake-specific 'biomanipulation-efficiency threshold' of the phosphorus load should not be exceeded. Integrated water quality control, i.e, a combination of the strategy of load reduction with the strategy of 'ecotechnology', seems to be a very promising way. (Author's abstract)
W89-00019

CHEMICAL METHODS OF P-ELIMINATION IN THE TRIBUTARIES OF RESERVOIRS AND LAKES,
Wahnbachtalsperrenverband, Siegburg (Germany, F.R.).
J. Clasen, and H. Bernhardt.
Schweizerische Zeitschrift fuer Hydrologie SZHYA6, Vol. 49, No. 2, p 249-259, August 1987. 12 fig, 11 ref.

Descriptors: *Water pollution treatment, *Wahnbach Reservoir, *Lake restoration, *Phosphorus, *Eutrophic lakes, *Drinking water, *West Germany, Water management, Nonpoint pollution sources, Eutrophication, Turbidity, Agricultural runoff, Chlorophyll a, Light penetration, Hydrogen ion concentration.

Based on experiences gained at Wahnbach Reservoir (West Germany) the success of chemical phosphorus-elimination in tributaries is described with regard to eutrophication and subsequent improvement of the conditions for drinking water treatment. Starting in late 1977, a phosphorus elimination plant began operating using activated alumina filters. The plant is situated below a pre-reservoir on the main tributary to Wahnbach Reservoir. Other methods of control have been used to deal with agricultural runoff from the less significant tributaries. The following changes have been noted in the reservoir since phosphorus concentration in the reservoir since phosphorus removal was begun: decrease in phosphorus concentration in the reservoir, decrease in chlorophyll a concentration, increase in Secchi disk readings, and decrease in Oscillatoria rubescens abundance. Primary productivity also decreased during the observation period, as indicated by a decrease in the amount of summer season pH increase. (Sand-PTT)
W89-00020

EVALUATION OF LAKE RESTORATION IN SWEDEN,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
C. Forsberg.
Schweizerische Zeitschrift fuer Hydrologie SZHYA6, Vol. 49, No. 2, p 260-274, August 1987. 7 fig, 32 ref.

Descriptors: *Lake restoration, *Acid rain, *Eutrophic lakes, *Acidic water, *Water management, *Sweden, Phosphorus, Liming, Government supports, Air pollution.

A large portion of the water resources in Sweden has been afflicted by acidification and eutrophication. About 18,000 Swedish lakes are classified as acidified. The most effective external restoration measure is reducing acidifying emissions to the atmosphere. Sulphur emissions within Sweden have been reduced by more than 50% since the end of the 1970s. Partial recoveries from the influences of acidification are reported from some lakes in western Sweden. The most common internal restoration measure used to reclaim acidified lakes is liming. Positive effects, expressed as biological recolonization, have been obtained when liming sufficiently improved water quality. Chemical, but no biological goals have been identified for the liming program. Lake liming is looked upon as only a temporary defense strategy to be used until the emissions of acidifying compounds are sufficiently reduced. During the 1970s advanced wastewater treatment for phosphorus removal was developed as a means fo eutrophication control. About 850 treatment plants for P removal are serving 5.5 million persons and 320 biological plants 1.3 million persons. As a result of this program successful recovery was observed in many water. In many shallow lakes, recovery was delayed due to internal nutrient loading from the sediments. Other external measures such as diversion and reduction of nutrients from nonpoint sources are discussed. Experiences of biological (grass carp, biomanipulation), chemical (flocculation, sediment oxidation) and mechanical (sediment removal) measures and measures against oxygen deficiency and restoration of lowered and overgrown lakes are discussed and evaluated. It can be concluded that there is a need for more careful planning, improved methods and cooperation between different interests involved in lake restoration. Governmental grants have been allocated for external and internal restoration measures for nutrient reductions, and are at present given for liming operations in acidified lakes. (Sand-PTT)
W89-00021

NITROGEN BUDGET OF THE SCHELDT HYDROGRAPHICAL BASIN,
Universite Libre de Bruxelles (Belgium). Lab. d'Oceanographie.
For primary bibliographic entry see Field 5B.
W89-00155

IMMOBILIZATION OF LEACHABLE TOXIC SOIL POLLUTANTS BY USING OXIDATIVE ENZYMES,
Cook Coll., New Brunswick, NJ. Dept. of Biochemistry and Microbiology.
M. J. R. Shannon, and R. Bartha.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 7, p 1719-1723, July 1988. 4 tab, 14 ref.

Descriptors: *Soil contamination, *Hazardous materials, *Water pollution control, *Immobilization, *Enzymes, *Phenols, *Leaching, Soil management, Horseradish peroxidase, Chemical oxidation, Polymers, Fungi, Groundwater pollution, Infiltration.

Screening of leachable toxic chemicals in a horseradish peroxidase-H2O2 immobilization system established that immobilization was promising for most phenolic pollutants but not for benzoic acid, 2,6-dinitrocresol, or dibutyl phthalate. The treatment did not mobilize inherently nonmobile pollutants such as anilines and benzo(a)pyrene. In a separate study, an extracellular lactase in the culture filtrate of Geotrichum candidum was selected from five fungal enzymes evaluated as a cost-effective substitute for horseradish peroxidase. This enzyme was used in demonstrating the immobilization and subsequent fate of 14C-labeled 4-methylphenol and 2,4-dichlorophenol in soil columns. When applied to Lakewood sand, 98.1% of 4-methylphenol was leached through with distilled water. Two days after immobilization treatment with the G. candidum culture filtrate, only 9.1% of the added 4-methylphenol was leached with the same volume of water. Of the more refractory test pollutant, 2,4-dichlorophenol, 91.6% had leached at time zero and 48.5% had leached 1 day after the immobilization treatment. However, 2 weeks after immobilization, only 12.0% of the 2,4-dichlorophenol was leached compared with 61.7% from the control column that received no immobiliza-

tion treatment. No remobilization of the bound pollutants was detected during 3- and 4-week incubation periods. Enzymatic immobilization of phenolic contaminants in soil appears to be a promising technique for the reduction of groundwater pollution by such substances. (Author's abstract)
W89-00341

ENVIRONMENTAL EFFECTS OF PAPER INDUSTRY WASTEWATERS: AN OVERVIEW,
National Council of the Paper Industry for Air and Stream Improvement, Inc., New York.
For primary bibliographic entry see Field 5C.
W89-00362

FECAL COLIFORM FINGERTIP COUNT: A POTENTIAL METHOD FOR EVALUATING THE EFFECTIVENESS OF LOW COST WATER SUPPLY AND SANITATION INITIATIVES,
Leeds Univ. (England). Dept. of Civil Engineering.
J. V. Pinfold, N. J. Horan, and D. D. Mara.
Journal of Tropical Medicine and Hygiene, No. 91, No. 2, p 67-70, April 1988. 2 fig, 1 tab, 5 ref.

Descriptors: *Fingertip counts, *Coliforms, *Water quality, *Water supply, *Sanitation, Potable water, Drinking water, Public health, Domestic water, Pollutant identification, Performance evaluation, Sampling.

A rapid and simple procedure for the enumeration of fecal coliform bacteria present on the fingertips is described. The distribution of individual fecal coliform fingertip counts (FTCs) within households has been compared with a number of variables related to the availability of water supply and sanitation facilities. This showed a strong association between the fingertip count and the possession of in-house water connections. As an indicator the FTC provides a simple, objective, reliable and specific measure of the effectiveness of certain public health interventions. In spite of the small sample size, the limited range of interventions and the absence of health indicators in this preliminary study, the results suggest that further development of FTC would prove useful. (Lantz-PTT)
W89-00379

EXPERIENCES OF LONG-TERM DESTRATIFICATION IN A WATER SUPPLY IMPOUNDMENT IN CENTRAL ILLINOIS,
Illinois State Water Survey, Peoria. Water Quality Section.
R. K. Raman.
Transactions of the Illinois Academy of Science TISAAH, Vol. 80, No. 1 and 2, p 87-99, 1987. 4 fig, 6 tab, 4 ref.

Descriptors: *Destratification, *Water quality control, *Lake Eureka, Illinois, Iron, Manganese, Cyanophyta, Mixing, Aeration, Oxygen, Copper sulfate, Reservoirs, Taste, Odor, Algicides, Chlorine demand.

Lake Eureka, Illinois, was created in 1942 primarily to serve as a water supply source for the City of Eureka. Because of complaints about taste and odor in the finished waters, the city abandoned the lake and switched to groundwater as the water supply source in 1979. A detailed taste and odor investigation indicated that high concentrations of iron and manganese, and the dominance of blue-green algae in the lake waters, contributed to the problems in the finished waters. Lake destratification using a low-energy mechanical destratifier in the deepest part of the lake in combination with chelated copper sulfate application to control blue-green algae was tried in 1981 as a means of enhancing the lake water quality characteristics. The aerator destratied the lake and maintained adequate oxygen levels. Iron and manganese concentrations in the deep waters were reduced by 95 to 97% from the pre-destratification levels. Chlorine demand values have been reduced by more than half, and problem-causing blue-green algae have been brought under control. (Author's abstract)
W89-00403

IMPROVING WATER SUPPLY IN THAILAND,
Waterworks Authority, Bangkok (Thailand).
For primary bibliographic entry see Field 5F.
W89-00422

EUTROPHICATION OF LAKES AND RESERVOIRS: A FRAMEWORK FOR MAKING MANAGEMENT DECISIONS,
Geological Survey, Austin, TX. Water Resources Div.
For primary bibliographic entry see Field 5C.
W89-00439

DELAYED NUTRIENT RESPONSES TO THE LIMING OF LAKE GARDSJON, SWEDEN,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
O. Broberg.
Ambio AMBOCX, Vol. 17, No. 1, p 22-27, 1988. 6 fig, 1 tab, 43 ref.

Descriptors: *Acid lakes, *Water quality control, *Lake restoration, *Eutrophication, *Acid rain, *Sweden, *Nutrients, Hydrogen ion concentration, Organic pollutants, Dissolved organic matter, Lime, Phosphorus, Nitrogen, Lake Gardsjon, Alkalinity, Carbon, Water analysis, Chlorophyll.

The acidified lakes Gardsjon and Stora Hastevatten (reference lake) have been monitored since 1980. These lakes are situated in southwestern Sweden, in an area severely affected by acid deposition. In terms of improvements in pH and alkalinity, Lake Gardsjon was successfully limed (in spring of 1982). The short-term effect was mainly an increase in dissolved organic carbon (DOC) and chlorophyll a concentrations together with a decrease in particulate-nitrogen and carbon concentrations. Further development was characterized by a mineralization of the 'acid benthic flora' (algae and sphagnum), which was extensive in Lake Gardsjon before liming. This mineralization episode led to a further increase in DOC concentrations accompanied by increases in organic nitrogen and particulate phosphorus, nitrogen and carbon. This increase in particulate organic matter was mainly due to a bloom of the phytoplankton Cosmocladium perissum. This algal bloom was followed by a period of low oxygen concentrations in the deeper areas of Lake Gardsjon, with a subsequent release of sediment phosphorus. The possible mechanisms underlying the measured concentration changes of phosphorus, nitrogen and organic carbon in relation to the acid reference lake are considered and the results compared to those from other limed lakes. The question of whether or not liming in general can fully restore the chemical bases for primary production (i.e. the availability and amounts of the limiting nutrients phosphorus and nitrogen) is addressed. (Author's abstract)
W89-00441

STATE PROGRAM SOLVES COUNTY SALT STORAGE PROBLEM,
Portage County, WI.
M. D. Buss.
Public Works PUWOAH, Vol. 118, No. 8, p 58, July 1988.

Descriptors: *Deicers, *Salt, *Water pollution prevention, Leaching, Groundwater protection, Costs.

Piles of exposed, unsheltered road salt present serious environmental problems when rainwater leaches through the dicer and contaminates groundwater. To combat this concern, the Wisconsin Department of Transportation (DOT) encouraged its 72 counties to have storage capacity for 100% of their annual use of salt by September 1987. To encourage the counties to build adequate salt storage facilities, the DOT began a new program whereby money was budgeted upfront that would pay 100% of a county's cost to build a facility to store state salt. This new program gave Portage County a great opportunity to solve its particular storage problem. The total project cost $218,000, of which, $165,000 was for the actual structure. The remaining cost was for the purchase of five acres, landscaping, blacktop, and lighting. The county began site preparation in June 1987. For Portage County, which believes that proper salt storage will become mandatory, the DOT program will save money and the environment. (Lantz-PTT)
W89-00466

LAKE DREDGING BOOSTS RECREATIONAL AND ESTHETIC ENVIRONMENTS,
Creve Coeur Dept. of Public Works, MO.
V. K. Bhasin.
Public Works PUWOAH, Vol. 118, No. 8, p 78-79, July 1988.

Descriptors: *Lake restoration, *Lakes, *Dredging, *Recreation, Ramona Lake, Costs, Financing, Water depth, Landscaping, Beaches.

The recently dredged Ramona Lake and its surrounding park in Berkeley, Missouri provide a much needed water-based recreational facility for residents and visitors. Financing of the project was unique since all monies used came from the city's general revenue, with no matching state Federal funds. The project began with removal of a portion of an earthen dam to release water from the lake, followed by dredging and storage of dredged material on site for dewatering. Later, additional material was removed to provide a healthy environment for aquatic life by increasing the lake depth, and finally, the earthen dam was restored. Approximately 20,000 cu yd were removed. Other improvements included landscaping disturbed areas, providing walls of railroad ties, installing new lighting, making beach improvements, and constructing a new access road and an eight-ft wide path around the lake. The total cost of dredging, new access road, spillway, and other improvements, has been approximately $400,000. (Lantz-PTT)
W89-00468

EFFECTIVENESS OF AN URBAN RUNOFF DETENTION POND-WETLANDS SYSTEM,
Geological Survey, Altamonte Springs, FL.
E. H. Martin.
Journal of Environmental Engineering (ASCE) JOEDDU, Vol. 114, No. 4, p 810-827, August 1988. 4 fig, 5 tab, 11 ref.

Descriptors: *Water pollution control, *Storm runoff, *Urban runoff, *Detention reservoirs, *Ponds, *Wetlands, Suspended load, Suspended solids, Heavy metals, Lead, Zinc, Nutrients, Nutrient removal, Nitrogen, Phosphorus, Dissolved solids.

The effectiveness of a detention pond and wetlands in series in reducing constituent loads carried in runoff was determined. The detention pond was effective in reducing loads of suspended solids and suspended metals. Suspended-phase efficiencies for solids, lead, and zinc ranged between 42 and 66%. Nutrient efficiencies were variable, ranging for all species and phases from less than 0 to 72%. The wetlands generally were effective in reducing both suspended and dissolved loads of solids and metals. Total (dissolved + suspended) solids, lead, and zinc efficiencies ranged between 41 and 73%. Efficiencies for total nitrogen and phosphorus were 21 and 17%. The system, by combining the treatment of the pond and wetlands, was very effective in reducing loads of most constituents. Total solids, lead, and zinc efficiencies ranged between 55 and 83%. Total nitrogen and phosphorus efficiencies were 36 and 43%. (Author's abstract)
W89-00487

RIVER BASIN WATER QUALITY MANAGEMENT IN STOCHASTIC ENVIRONMENT,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Industrial Engineering and Management.
O. Fujiwara, W. Puangmaha, and K. Hanaki.
Journal of Environmental Engineering (ASCE) JOEDDU, Vol. 114, No. 4, p 864-877, August 1988. 3 fig, 6 tab, 14 ref.

Descriptors: *Water quality management, *Water pollution control, *Model studies, *Simulation analysis, *Stochastic hydrology, Wastewater treat-

ment, Burn and McBean model, Monte Carlo method, River basins, Optimization, Water quality standards, Dissolved oxygen, Oxygen deficit.

The stochastic model of Burn and McBean, which considers various river parameters as random variables and optimizes wastewater treatment efficiencies at source points was modified. Instead of first-order uncertainty analysis, a Monte-Carlo simulation was used to calculate quantiles of random variables concerning dissolved oxygen (DO) concentration. With the objective of restricting violation of water-quality standards to within maximum-allowable probability levels, an iterative procedure for optimization and simulation was developed. A chance-constrained program with equal weight on DO concentration at each checking point was solved. A simulation analysis was used to calculate the probability of violating the DO-deficit standard at each checking point. The weight put on DO concentration was then adjusted according to the acceptable level of this probability. Whenever no weight change occurred, the budget was increased and the chance-constrained program was solved again with the new budget and the new weights. The weight-change process was repeated until acceptable violation levels were achieved. (Author's abstract)
W89-00490

MIXING OF TEMPERATURE-STRATIFIED LAKES AND RESERVOIRS BY BUOYANT JETS,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
R. Gu, and H. G. Stefan.
Journal of Environmental Engineering (ASCE) JOEDDU, Vol. 114, No. 4, p 898-914, August 1988. 12 fig, 1 tab, 19 ref.

Descriptors: *Lakes, *Reservoirs, *Hydraulics, *Mixing, *Thermal stratification, *Lake restoration, *Water quality control, *Jets, Buoyancy, *Destratification, Temperature effects, Simulation analysis, Prediction, Numerical analysis, Design criteria.

Mixing by means of jets which are created by withdrawing water from one layer and injecting it into another layer was examined. The physical features of the thermal destratification were investigated by analysis and experiment. A one-dimensional simulation model was devised to predict the process of mixing, which is reflected by changes in temperature-depth profiles. The simulation results are compared with existing field data. Experiments on the mixing of stratified water by buoyant jets were also carried out in a laboratory tank. The results are presented and compared with those predicted by the simulation to verify the validity of the model. The generalized results of laboratory experiments and numerical simulation are summarized to provide some design information for the selection of mixing systems for lake and reservoir destratification. (See also W89-00491) (Author's abstract)
W89-00492

SETTING THE WATER QUALITY AGENDA: 1988 AND BEYOND,
M. Hegewald.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 5, p 588-593, May 1988.

Descriptors: *Water quality management, *Long-term planning, *Water pollution control, Federal jurisdiction, Water Quality Act.

The Water Quality Act of 1987 signaled a shift in emphasis from control of point source discharges to broader water quality objectives. Consequently, it is recommended that federal agencies foster flexibility in developing local approaches to manage new pollution sources. This should result in more accountability for state and local officials to their constituents. In order to set appropriate priorities, state and local legislators and regulators will have to be educated about what water quality technicians do and about the benefits of their operations. The treatment works operators and other water quality technicians must take an active part in educating their service customers. Eliminating much of the remaining pollution problem will require individuals to either change their behavior or pay more for their water related services or both. Future improvements in water quality should be no more difficult than cultivating the proper perspective. (Author's abstract)
W89-00505

LOAD ALLOCATION FOR TOXICS USING MONTE CARLO TECHNIQUES,
J. K. Marr, and R. P. Canale.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 5, p 659-666, May 1988. 8 fig, 2 tab, 20 ref.

Descriptors: *Water quality control, *Pollution load, *Wastewater disposal, *Toxic wastes, *Fate of pollutants, *Monte carlo method, Probability distribution, Effluents, Mathematical studies, Wastewater, Rivers.

The ability of a probabilistic water quality model to calculate toxic pollutant concentration variations in streams is demonstrated. The model improves evaluation of effluent limitations for a point source discharger to river or stream systems. The model is based on statistical characterizations of relevant system input parameters and a repetitive Monte Carlo framework using standard microcomputer technology. Model results compared favorably with actual measurements of surface waters. Model simulations are used to forecast stream concentrations and evaluate alternative effluent limits for wastewater treatment. A new method is suggested for determining toxic effluent limits based on probabilistic analyses. (Author's abstract)
W89-00514

CITIZEN SUITS UNDER THE CLEAN WATER ACT: WAITING FOR GODOT IN THE FIFTH CIRCUIT,
For primary bibliographic entry see Field 6E.
W89-00517

TOXIC AND ENVIRONMENTAL TORTS WITHIN ADMIRALTY,
Hunton and Williams, Norfolk, VA.
For primary bibliographic entry see Field 6E.
W89-00518

HAZARDOUS AND NOXIOUS SUBSTANCES,
D. A. Bagwell.
Tulane Law Review, Vol. 62, No. 2 & 3, p 433-464, February 1988.

Descriptors: *Hazardous materials, *Oil pollution, *Water pollution control, *Path of pollutants, *Legal aspects, *Water law,Law of the seas, Federal jurisdiction, State jurisdiction, Seawater.

The legal consequences of an oil spill from a ship could vary significantly under federal law depending upon where the oil was loaded, and under state law depending upon which state(s) the spill happens to involve. This diverse composition of law and precedent has resulted in inconsistent and expensive application of federal and state laws. The pertinent laws, including the Federal Water Pollution Control Act, the Comprehensive Environmental Response, Compensation and Liability Act of 1980, the Outer Continental Shelf Lands Act, the Trans-Alaska Pipeline Authorization Act, and the Deepwater Port Act of 1974, are reviewed. Aspects of the federal common law, the general maritime law, state statutes, various conventions and protocols, and foreign law also are discussed. The need for Congressional reform is emphasized. (Hammond-PTI)
W89-00519

INTERNATIONAL CONTROL OF CROSS-MEDIA POLLUTION: AN ECOSYSTEM APPROACH,
Fordham Univ., Bronx, NY. School of Law.
L. A. Teclaff, and E. Teclaff.
Natural Resources Journal NRJOAB, Vol. 27, No. 1, p 21-53, Winter 1987.

Descriptors: *Water law, *Path of pollutants, *Ecosystems, *River basins, *International commissions, *Environmental policy, International agreements, Environmental control, Water pollution control.

Cross-media pollution, or the transfer of pollutants from one environmental medium to another, is a growing international problem that long escaped attention because treaties and the institutions to implement them were devised usually to protect only one element of the environment--air, land, or water. A more holistic, ecosystem approach is needed for so complex an issue, and this article suggests the river basin as an areal unit for that approach. After analyzing the functions of existing international basin commissions, the article concludes that if their functions were appropriately expanded these entities would be eminently suitable to deal with cross-media pollution, thereby dispensing with the need to create new institutions to manage this old but newly discovered problem. (Author's abstract)
W89-00520

GLOBAL ENVIRONMENT: A PROPOSAL TO ELIMINATE MARINE OIL POLLUTION,
Texas Univ. at Austin. School of Law.
B. Shaw, B. J. Winslett, and F. B. Cross.
Natural Resources Journal NRJOAB, Vol. 27, No. 1, p 157-185, Winter 1987. 1 tab.

Descriptors: *Water pollution control, *Marine environment, *International law, *Oil pollution, Oil tankers, Economic evaluation, Ethics, Environmental policy, Environmental control, International agreements.

The authors begin their examination of the ocean pollution problem with a review of recent tanker accidents that have had long- and short-term effects on the integrity of marine ecology. Further inquiry leads to a focus on flagship-of-convenience tankers that appear to contribute disproportionately to the oil production problem but are not the sole cause. Routine discharges of oil ballast by the tanker fleets of all registries are even more at fault. The authors then explore both international and unilateral efforts to reduce the problem, or at least contain its dimensions. Finding these efforts to be unavailing, the authors propose an economic incentive/disincentive system that can be implemented internationally or unilaterally, and a phasing out of flagships-of-convenience. In a closing segment of the paper, the authors reinforce their legal and economic analysis with an evaluation of the relevant ethical issues that are involved. (Author's abstract)
W89-00521

SOURCES OF WATERCOURSE POLLUTION IN ITALY AND MEDITERRANEAN FRANCE, ASSESSED BY MACROPHYTES,
For primary bibliographic entry see Field 5B.
W89-00563

PROCEDURE FOR EVALUATING MUNICIPAL SOLID WASTE LEACHATE COMPONENTS CAPABLE OF CAUSING VOLUME SHRINKAGE IN COMPACTED CLAY SOILS,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5E.
W89-00621

INTERMITTENT DESTRATIFICATION: A THERAPY MEASURE AGAINST CYANOBACTERIA IN LAKES,
Bayerische Landesanstalt fuer Wasserforschung, Munich (Germany, F.R.).
C. Steinberg, and G. M. Zimmermann.
Environmental Technology Letters ETLEDB, Vol. 9, No. 4, p 337-350, April 1988. 7 fig, 2 tab, 37 ref.

Descriptors: *Destratification, *Lake restoration, *Cyanophyta, *Eutrophication, Sediment-water interfaces, Phytoplankton, Lakes, Isotherms,

Oxygen, Acidity, Nutrients, Transparency, Optical properties, Oscillatoria, Fishkaltersee, Germany, Diatoms, Chlorophyta, Sedimentation.

The use of intermittent destratification to restore eutrophic lakes was studied in Lake Fischkaltersee in Upper Bavaria, after several other measures (chemical phosphorus immobilization, permanent destratification) had been attempted. Filamentous cyanophytes were dominant within the phytoplankton community prior to treatment. Water samples were taken and temperature, pH, and base capacity determined each time the compressor was turned on or off. During intermittent stratification, the uniform movement of the water masses suddenly stops when the compressor is switched off. The isopleths of temperature, oxygen, phosphorus, and mineral nitrogen compounds show that the water began to stratify during the undisturbed phase. This permits sedimentation to occur, destroying the advantage of the cyanophytes. (Under permanent destratification, cyanophytes are initially outcompeted by chlorophytes and diatoms but regain their dominance in the third year.) Possible reasons why cyanophytes cannot adapt fast enough to the conditions of destratification are discussed. Intermittent destratification works quickly and seems to be applicable even in relatively shallow lakes (< 15 m) in which permanent destratification may be risky. It is also expensive than permanent destratification. (Doria-PTT)
W89-00639

COST EFFICIENCY OF TRANSFERABLE DISCHARGE PERMIT MARKETS FOR CONTROL OF MULTIPLE POLLUTANTS,
Illinois Univ., Urbana. Dept. of Civil Engineering.
B. J. Lence, J. W. Eheart, and E. D. Brill.
Water Resources Research WRERAO, Vol. 24, No. 7, p 897-905, July 1988. 3 fig, 3 tab, 21 ref. NSF Grant PRA-81 21692 and EPA Grant CR812577.

Descriptors: *Regulations, *Economic efficiency, *Discharge permits, *Water pollution control, *River basins, *Wastewater management, *Wastewater treatment, Transferable discharge permit programs, Cost analysis, Scenarios, Biochemical oxygen demand, Phospores, Nitrogen, Municipal wastewater.

Transferable discharge permit (TDP) programs for managing multiple pollutants may be complicated by interdependent treatment costs. Under such systems pollutants may be managed as several individual commodities or grouped together and managed as a single commodity. An approach is presented for evaluating the cost efficiency of TDP programs in which permits for several pollutants are traded as individual commodities. Two market scenarios, representing simultaneous and sequential TDP markets, are developed to provide high and low benchmarks for cost efficiency, respectively. The scenarios demonstrate the control of biochemical oxygen demand (BOD), phosphorus, and nitrogen discharges in a typical river basin. A method for estimating feasible transfer payments under the market scenarios is also described and demonstrated for markets for BOD and phosphorus permits. The costs of these scenarios are compared with each other and with that of a uniform treatment approach. These comparisons suggest that a TDP program that manages several pollutants on an individual basis is a cost-effective management strategy for conventional municipal pollutants and that any interdependencies that exist among these pollutants in terms of waste treatment costs do not limit the effectiveness of this simple program. (Author's abstract)
W89-00697

LAKE TREATMENT WITH ALUM,
General Chemical Corp., Syracuse, NY.
R. Lee.
Public Works PUWOAH, Vol. 119, No. 9, p 56-58, August 1988. 3 fig.

Descriptors: *Lakes, *Water quality management, *Lake restoration, *Alum, *Aluminum sulfate, *Chemical treatment, Phosphorus, Lake sediments, Chemical precipitation, Flocculation, Transportation, Costs, Navigation, Personnel, New York, Vermont.

In one method used successfully in the United States and Europe to inactivate phosphorus in lake sediments, alum, or aluminum sulfate, is added, forming aluminum hydroxide and aluminum phosphate. A sufficiently thick layer of these precipitates seals the sediments and inhibits phosphorus release to the water. The amount of alum needed to generate sufficient amounts of aluminum hydroxide floc depends on the coagulant demand, phosphorus concentration of the water, and the target phosphorus level. Laboratory jar tests are used to define the relative quantities of alum needed. So long as transportation costs are reasonable, the chemicals needed are best delivered as aqueous solutions for ease in handling and application. The initial portion of the treatment program should involve a one-day or two-day pilot program to evaluate the logistics and effectiveness of alum application. Both dry and liquid forms of alum have been used to treat lakes. The logistics of treatment should be worked out in advance and include such areas as chemical delivery, navigation, and coordinating those involved in unloading the chemicals, operating the vessel, applying chemicals, and setting navigation aids. As many as ten people may be needed to make a program work. Two lake treatment projects: Irondequoit Bay in New York State and Lake Morey in Vermont. (Shidler-PTT)
W89-00745

OIL POLLUTION IN THE CROMARTY FIRTH AND INSHORE MORAY FIRTH,
Nature Conservancy Council, Edinburgh (Scotland).
For primary bibliographic entry see Field 5B.
W89-00785

REGULATION OF POLLUTION: CONTROLS AND RESPONSIBILITIES,
Highland River Purification Board, Dingwall (Scotland).
For primary bibliographic entry see Field 6E.
W89-00786

POLLUTION CONTROL AND ENVIRONMENTAL PLANNING FOR THE BEATRICE OILFIELD AND NIGG OIL TERMINAL,
Britoil PLC, Aberdeen (Scotland).
D. M. Shaw, and S. Batt.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 91, p 301-313, 1986. 6 fig.

Descriptors: *Scotland, *Nigg Bay, *Beatrice oilfield, *Management planning, *Oil pollution, *Water pollution control, North Sea, Moray Firth, Environmental impact study, Baseline studies, Monitoring, Oil fields, Environmental effects, Ecological effects, Estuaries, Rivers, Coastal waters.

The Beatrice Oil field development, in Moray Firth (Scotland), presented particular challenges in the area of environmental protection. Planning and development consents depended greatly on the development of a viable and credible environmental protection plan. The overall plan was based on an impact study followed by baseline environmental studies which formed the basis for a continuing monitoring program. The Beatrice development, the three-phase environmental program (impact study, baseline studies, monitoring program), pollution prevention and control planning, and offshore and inshore containment and recovery procedures and equipment are described. (See also W89-00775) (Alexander-PTT)
W89-00788

MARINE POLLUTION IN ORKNEY,
Marine Lab., Aberdeen (Scotland).
I. M. Davies.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 87, No. 1/2, p 105-112, 1985. 5 fig, 3 tab, 19 ref.

Descriptors: *Scotland, *Cadmium, *Orkney Islands, *Coastal waters, *Legal aspects, *Water law, *Water pollution control, Water pollution effects, Bioaccumulation, Hydrocarbons, Chlorinated hydrocarbons, Organic compounds, Heavy metals, Tissue analysis, Chemical analysis, Regional analysis, Fish, Water pollution sources, Path of pollutants.

This paper briefly reviews the legal framework of pollution control in Orkney, and discusses the occurrence of the main categories of contaminants there. There is no indication of elevated concentrations of organohalogen compounds in Orkney shellfish. The main potential source of hydrocarbon. contamination is thoroughly monitored, and no major adverse effect has been noted. High concentrations (up to 62 micrograms/g wet wt) of cadmium occur in edible crab hepatopancreas from Orkney, Shetland and surrounding areas. A consideration of cadmium concentrations in a range of species suggests a regional geochemical anomaly for cadmium, affecting biota perhaps through solid phases. (Author's abstract)
W89-00796

MIGRATORY SALMONIDS OF THE ESTUARY AND FIRTH OF CLYDE,
Clyde River Purification Board, East Kilbride (Scotland).
D. W. Mackay, and C. R. Doughty.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 90, p 479-490, 1986. 2 fig, 31 ref.

Descriptors: *Scotland, *Spawning, *Salmon, *Sea trout, *Clyde Estuary, *Firth of Clyde, Coastal waters, Reproduction, Water pollution control, Estuaries, Rivers, Fish passages, Weirs, Fish stocking, Regional planning, Riffles.

The salmon and sea trout stocks of the rivers entering the sea via the Estuary and Firth of the Clyde including the Rivers Clyde, Leven, the Carts, the rivers of the Ayrshire coast and those entering via the sea lochs and from the Mull of Kintyre are described. Particular attention is paid to the recent return of salmonids to the Rivers Clyde and Cart, which have not been used by migratory species for more than a century because of pollution in the upper Clyde Estuary. The changing environmental conditions, which have made the reappearance of migratory salmonids possible, include a reduction in the level of organic pollution entering the Clyde estuary and an adequate supply of invertebrate food. A management strategy that would enhance the use of the Clyde estuary and its tributary streams by migrating salmon and sea trout includes: (1) stocking the streams artificially with eyed ova or fry; (2) construction of fish passages or trapping ascending adults and transporting them byroad around obstacles; (3) habitat mangement by the introduction of riffle pools, bankside vegetation, and artificial spawning channels; and (4) additional pollution control measures including full biolgical treatment of sewage which does not seem likely in view of current restrictions on public spending. (Alexander-PTT)
W89-00828

CLEAN AIR ACT-TRANSBOUNDARY ACID RAIN POLLUTION ABATEMENT-ADMINISTRATIVE DISCRETION CITIZEN SUIT,
B. A. Ohline.
Natural Resources Journal NRJOAB, Vol. 27, No. 3, p 707-722, Summer 1987. 145 ref.

Descriptors: *Clean Air Act, *Acid rain, *Water law, *Political aspects, *Legal aspects, Economic aspects, Photosynthesis, Air pollution effects.

As an international environmental problem, acid rain is difficult to understand scientifically, difficult to control technologically, and difficult to handle politically because of its economic and diplomatic consequences. The complex issues of transboundary acid rain were taken to U.S. courts in State of New York v. Thomas (Thomas), a unique citizen suit brought under the international provision of the Clean Air Act (CAA) to compel pollution emission reductions in this country for the protection of the citizens of Canada. The district court in

Thomas I became the first in this nation's history to order the executive branch to abate acid rain to protect another country. The appellate court, however, reversed the lower court decision. The U.S. Supreme Court denied petitions for certiorari. Although the plaintiffs were not able to compel implementation of an abatement program, the Thomas litigation offers lessons on the American legal system and international politics. The case demonstrates the court's unwillingness or inability to handle complex, international issues without clear support of Congress and the executive branch. Both the rationale of the appellate court decision and the policy issues which influenced that decision are examined. (Alexander-PTT)
W89-00839

RELIABILITY OF CHEMICAL ANALYSES OF WATER SAMPLES: THE EXPERIENCE OF THE UMTRA PROJECT,
Weston (Roy F.), Inc., Albuquerque, NM.
For primary bibliographic entry see Field 5A.
W89-00941

WATER QUALITY MANAGEMENT: A REGIONAL PERSPECTIVE-THE SEVERN-TRENT AREA,
Severn-Trent Water Authority, Birmingham (England).
D. J. Brewin, and J. R. Martin.
Regulated Rivers Research and Management RRRMEP, Vol. 2, No. 3, p 257-275, July-August 1988. 3 fig, 4 tab, 26 ref.

Descriptors: *River regulations, *Rivers, *Water quality management, Water quality standards, *England, *Model studies, Catchment areas, Effluents, Severn River, Trent River.

The management of water quality in the U.K. rivers is going through a period of major change due to the proposed organization of the water industry, the increasing demands on river resources and the imposition of stricter environmental standards. Changes to the river classification scheme and effluent consent conditions are discussed. A brief summary is given of some of the water quality problems that are of particular concern in the Seven-Trent area: toxic metals in treated wastewater effluents, thermal pollution by electric powerplants, combined sewer overflows, and agricultural runoff. The impact on quality of river regulation, including in-river purification lakes, is described. Catchment models developed to assist with the management of river resources include the Trent Economic Model (river quality model, a resource allocation model, and an investment model), Monte Carlo simulation models used to calculate consent conditions, and time of travel models to obtain information during pollution incidents. (Miller-PTT)
W89-00951

ENCAPSULATED HERBICIDES COULD CURB GROUND WATER POLLUTION,
Agricultural Research Service, Beltsville, MD.
R. P. Kaniuka.
Water Well Journal WWJOA9, Vol. 42, No. 8, p 34-35, August 1988.

Descriptors: *Water pollution prevention, *Groundwater pollution, *Herbicides, *Pesticides, Agricultural chemicals, Leaching, Irrigation practices.

A strategic plan adopted by the Agriculture Department's Agricultural Research Service to provide American farmers with a series of management practices is discussed. Starch-encapsulated, time-release herbicides help to keep chemicals from leaching out of the crop's root zone and to reduce the movement of pesticides into groundwater. Among the pesticides studied are atrazine, alachlor, metribuzin, carbofuran, EPTC and trifluran. There are five priorities in the strategic plan: (1) conservation tillage may increase the potential for pesticide leaching, (2) pesticide applications can be timed with average dates of lower rainfall using GLEAMS (a user-friendly computer model), (3) combined integrated pest and weed management systems can help reduce pesticide poundage for crops, (4) various irrigation systems can be better managed to prevent deep leaching of pesticides, and (5) better analytical and predictive technologies and methods for remedying pollution problems are needed. (Miller-PTT)
W89-00964

PROBLEM WITH NITRATES,
For primary bibliographic entry see Field 5B.
W89-00965

NONAQUEOUS PHASE LIQUID TRANSPORT AND CLEANUP: I. ANALYSIS OF MECHANISMS,
California Univ., Berkeley. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-00968

NONAQUEOUS PHASE LIQUID TRANSPORT AND CLEANUP: II. EXPERIMENTAL STUDIES,
California Univ., Berkeley. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-00969

ANALYTICAL SOLUTION FOR AQUIFER DECONTAMINATION BY PUMPING,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
C. Chen, and G. D. Woodside.
Water Resources Research WRERAO, Vol. 24, No. 8, p 1329-1338, August 1988. 9 fig, 18 ref. 2 append. NSF Grant ECE-8696079.

Descriptors: *Decontamination, *Pumping, *Mathematical analysis, *Model studies, *Groundwater pollution, *Aquifer management, *Cleanup operations, Pump wells, Sinks, Plumes, Path of pollutants, Remedies, Flow rates, Injection wells, Mathematical studies, Flow pattern, Pumps, Wells, Pump wells, Groundwater.

The use of withdrawal wells to extract dissolved solutes for contaminated aquifers is a possible mechanical remedial technique for polluted aquifers. A mathematical model dealing with aquifer decontamination by pumping is developed. The pumping well with a constant flow rate is taken into account as a mathematical sink located at the center of the plume to be removed. This plume is assumed to have a circular geometry inside which the solute concentration is axially symmetric with respect to the well and is incorporated into the model as an initial condition that can be formulated in an analytic or a sectionally continuous function capable of representing a wide range of uniform or nonuniform profiles. it assumes advection and longitudinal mechanical dispersion to be the transport mechanisms on a radially converging groundwater flow field. The analytical solution detecting concentration variation inside the aquifer is determined in closed forms with the Greens's function approach and the Laplace transform technique. Using the field data presented of Pickens and Grisak, the analytical solution obtained very accurately reproduces the reported concentration history at the well during the withdrawal phase of the single-well injection-withdrawal tracer test. It is found that if the initial conditions are expressed in functions presenting noticeable concentration gradients at the plume boundary, adverse dispersion against the converging groundwater movement would cause spreading of solute beyond the original extent of plume during pumping. If the initial conditions gradually decrease to zero concentration at the plume boundary where negligible concentration gradients exists, concentration distributions do not extend beyond the initial condition envelopes during the withdrawal process. Since the well is placed at the center of the plume where maximum concentration occurs, the analytical solution evaluated at the well bore can be employed to indicate the decontamination level achieved at various pumping times. Graphical relations are presented for approximating the pumping time required to lower the concentration at the well bore to 1% of the maximum initial concentration. (Author's abstract)
W89-00977

NATIONAL WATER MANAGEMENT IN THE REPUBLIC OF SOUTH AFRICA: TOWARDS A CONSULTATIVE PARTNERSHIP WITH DIVERSE USERS IN A SEMI-ARID COUNTRY,
Department of Water Affairs, Pretoria (South Africa).
For primary bibliographic entry see Field 6D.
W89-01029

MYXOCOCCAL PREDATION ON CYANOBACTERIAL POPULATIONS: NUTRIENT EFFECTS,
Toledo Univ., OH. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W89-01050

CALIFORNIA TAHOE CONSERVANCY: APPLYING THE PRINCIPLES,
California Tahoe Conservancy, Lake Tahoe.
For primary bibliographic entry see Field 6E.
W89-01068

WETLAND PROJECTS OF THE CALIFORNIA STATE COASTAL CONSERVANCY: AN ASSESSMENT,
Zentner and Zentner, San Francisco, CA.
For primary bibliographic entry see Field 6E.
W89-01069

PROSPECTS FOR TRANSFER OF THE CALIFORNIA COASTAL CONSERVANCY MODEL FOR HABITAT RESTORATION TO OTHER COASTAL STATES,
McCreary (Scott), Cambridge, MA.
For primary bibliographic entry see Field 6E.
W89-01070

SOURCE PROTECTION AND THE SMALL UTILITY,
Chautauqua County Dept. of Health, Mayville, NY. Div. of Environmental Health Services.
W. D. Gollnitz.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 8, p 52-57, August 1988. 2 fig, 1 tab, 10 ref.

Descriptors: *Water quality control, *Water pollution sources, *Path of pollutants, *Watershed management, *Water source protection, *Small water systems, Chautauqua Creek, Minton Reservoir, Westfield watershed, New York, Oil pollution, Sediment control, Brines, Erosion, Vegetation, Land use, Food processing, Management planning, Vine crops, Model studies.

Protection of a water supply source is important in the management of a small water utility. However, these small systems rarely have experts on staff or funds for source protection. The components of a source protection plan are scoping (defining the problem and eliminating irrelevant concerns), watershed analysis, pollutant analysis, evaluation of current controls, and plan development. This procedure is illustrated in a case study of the Westfield watershed, Chautauqua County, New York, where the Chautauqua Creek and Minton Reservoir serve as sources for the large quantities of high-quality water needed in Concord grape processing. Scoping indicated that land use activities, especially oil and gas development and extraction, could significantly impact the water quality from sediment and brines produced at well sites. Watershed analysis established the physical nature of the area, which is glacial till overlying bedrock. Vegetation cover is 90 and 75% of the Minton Reservoir and Chautauqua Creek watersheds, respectively. Pollutants were analyzed with a brine impact model and an erosion-sedimentation model. The plan developed from the study includes the following provisions: changes in environmental regulations for mineral resources will be suggested to the state legislature; watershed land will be purchased, especially

around hydrologically sensitive areas; Critical Environmental Areas will be designated within a 1-mi radius upstream from the raw water intakes; rules and regulations will be adopted to address oil and gas development activities; and a water monitoring program will be established. (Cassar-PTT)
W89-01116

LOOK TO THE FUTURE: ENVIRONMENTAL EDUCATION,
Texas Univ. at Austin. Dept. of Environmental Health Engineering.
E. F. Gloyna, and C. A. Sorber.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 7, p 1193-1198, July 1988. 1 fig, 1 tab, 17 ref.

Descriptors: *Education, *Environmental engineering, *Engineering personnel, *Economic aspects, *Legal aspects, *Social aspects, Engineering.

Engineering education is examined and environmental engineering, in particular, is discussed with the idea of providing a new direction. The most difficult challenges for the future environmental engineer will be those that arise from an overpopulated industrialized society. These include health-related problems associated with groundwater protection, nonpoint source pollution control, toxics regulation, hazardous waste disposal. Solutions to these and other challenges do not depend solely on good science, but may require economic, social, legal and ethical considerations as well. Environmental engineering education must satisfy several criteria: (1) it must provide a foundation for a lifelong educational process, (2) the formal courses and research experiences must enhance the total body of knowledge, and (3) the study of environmental engineering must ultimately contribute to an improved quality of life. Employers of engineers generally agree that undergraduate engineering students are better prepared than ever. However, it is apparent that significant gaps are beginning to appear. Complaints generally concern lack of communications skills, the ability to cope with public policy issues, lack of management and leadership capabilities and an inadequate appreciation of related disciplines. In specialized disciplines, such as environmental engineering, the breadth and depth of course content is becoming increasingly inadequate. Unless environmental engineers increase their educational scope, the discipline may be relegated to options in other mainline engineering programs. (Miller-PTT)
W89-01121

EVALUATION OF VEGETATION FILTER STRIPS AS A BEST MANAGEMENT PRACTICE FOR FEED LOTS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Engineering.
T. A. Dillaha, J. H. Sherrard, D. Lee, S. Mostaghimi, and V. O. Shanholtz.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 7, p 1231-1238, July 1988. 7 fig, 3 tab, 14 ref.

Descriptors: *Feedlot runoff, *Nonpoint pollution sources, *Water pollution control, *Surface runoff, Suspended solids, Vegetative filter strips, Sediment, Nutrients, Nitrogen, Phosphorus, Phosphorus removal.

Vegetative filter strips were studied as an effective test management practice for the control of some nonpoint source pollutants. Field experiments designed to investigate the transport of sediment, nitrogen and phosphate from areas of confined livestock activity, as influenced by flow characteristics and filter strip length, were conducted. Results indicated that vegetative filter strips are effective for the removal of sediment and other suspended solids contained in surface runoff from feedlots if runoff is shallow and uniform. Effectiveness of vegetative filter strips for sediment removal decreases with time as sediment accumulates within the filters. Total nitrogen and phosphorus are not removed as effectively as sediment; soluble nitrogen and phosphorus are not removed effectively. (Author's abstract)
W89-01125

ROLE OF ECONOMIC BENEFITS ANALYSIS IN FUNDING MARINE COMBINED SEWER OVERFLOW PROJECTS - CASE STUDY OF BOSTON HARBOR,
Environmental Protection Agency, Washington, DC.
For primary bibliographic entry see Field 6C.
W89-01132

DIFFUSE (NONPOINT) POLLUTION - A POLITICAL, INSTITUTIONAL, AND FISCAL PROBLEM,
Marquette Univ., Milwaukee, WI. Dept. of Civil Engineering.
V. Novotny.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 8, p 1404-1413, August 1988. 1 tab, 33 ref.

Descriptors: *Nonpoint pollution sources, *Water pollution control, Political constraints, *Water policy, *Costs, Symposium, Institutional constraints.

Nonpoint pollution sources, defined as ground or surface water associated with diffuse land use activities that ultimately cause water quality degradation, are discussed. Common definitions of nonpoint pollution specified it as pollution originating from diffuse sources, which can be land-based or airborne. Diffuse pollution abatement crosses political boundaries and regional or water-shed-wide solutions often require international or interstate cooperation. Examples include the Great Lakes Systems and the Chesapeake Bay. In the U.S., however, regional solutions have not been pursued. Diffuse source pollution control often involves conflicting powerful interests, notably the farm and real estate development. Considering the policy alternatives and the criteria by which alternatives are judged and selected, the constraints and decision variables for the design of a diffuse pollution program can be placed into three categories: (1) economic-fiscal variables and constraints that include economic feasibility, (2) political constraints and variables that include equity criterion, and (3) institutional variables and criteria that include feasibility of implementation. (Miller-PTT)
W89-01134

COPING WITH GROUNDWATER CONTAMINATION,
Johns Hopkins Univ., Baltimore, MD. Dept. of Environmental Engineering Science.
E. Bouwer, J. Mercer, M. Kavanaugh, and F. DiGiano.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 8, p 1415-1427, August 1988. 2 fig, 8 tab, 63 ref.

Descriptors: *Water pollution treatment, *Path of pollutants, *Groundwater movement, *Groundwater pollution, Environmental effects, Cleanup, Chemical properties, Physical properties, Feasibility studies.

Management of groundwater contamination cleanup, requiring characterization of the site and development of remediation strategies, is discussed. An assessment of both the groundwater flow system and groundwater quality is needed to determine the processes that control transport of contaminants from a site. Selection of an appropriate treatment strategy for groundwater remediation relies on the results of the site characterization and specification of target clean-up levels. Options include containment of surface and groundwater, treatment of extracted water, and in situ treatment. Contaminant physical and chemical properties are useful to screen applicable technologies. Because of the uncertainty in health and environmental effects, the newness of control efforts, the limited knowledge of transport and fate processes, and the multidisciplinary complexity of the problem, much research is needed. Education in fundamental principles will improve the ability to meet the groundwater challenge. (Miller-PTT)
W89-01135

QUALITY CONTROL APPROACH TO NPDES COMPLIANCE DETERMINATION,
Construction Engineering Research Lab. (Army), Champaign, IL.
For primary bibliographic entry see Field 5D.
W89-01136

UPTAKE AND DISTRIBUTION OF COPPER SULPHATE AND ITS EFFECT ON THE RESPIRATION RATE OF THE HEMOCYANIN-PRODUCING FRESHWATER SNAIL LYMNAEA NATALENSIS,
Potchefstroom Univ. for C.H.E. (South Africa). Dept. of Zoology.
C. T. Wolmarans, and E. Yssel.
Bulletin of Environmental Contamination and Toxicology BECTA6. Vol. 41, No. 2, p 214-221, August 1988. 1 fig, 2 tab, 12 ref.

Descriptors: *Molluscicides, *Toxicity, *Copper sulfate, *Snails, *Animal metabolism, Respiration, Hemocyanin, Trematodes, Aquatic animals, Absorption, Parasites, Bilharzia, Public health, Animal tissues, Tissue analysis.

Copper sulfate was one of the earliest compounds suggested as a molluscicide and, although several new compounds have since been developed, it is still widely used against snail intermediate hosts of trematode parasites causing bilharzia. The uptake of external copper, as well as the effect of this ion on respiration rate, was investigated in Lymnaea natalensis, the intermediate host of Fasciola gigantica; this snail possesses hemocyanin as a respiratory pigment. An increase in copper concentration occurred in the head-foot tissue, digestive gland, and hemolymph after exposure to copper for 2 hours. It could be deduced that copper was probably taken up by absorption at the head-foot tissue and by metabolic interaction in the digestive gland. It also appeared that copper reached the digestive gland via the blood pathways and then accumulated there for as long as exposure was maintained. The copper taken up in the hemolymph did not influence the copper-containing respiratory protein of the snails. This leads to the question of how copper sulfate can promote lethality in snails. The authors are of the opinion that lethality results from a negative effect of copper on the exposed epithelium, which in turn leads to a disturbance in the osmoregulatory processes of the snails. (Shidler-PTT)
W89-01155

MONITORING OF LIQUID EFFLUENTS AS PREVENTATIVE PROTECTION OF NATURAL BODIES OF WATER (ABWASSERUBERWACHUNG ALS VORBEUGENDER GEWASSERSCHUTZ),
BASF A.G., Ludwigshafen am Rhein (Germany, F.R.). Zentralbereich Ingenieurtechnik Fachkonstruktion.
T. Frech.
Chemieingenieurtechnik CITEAH, Vol. 60, No. 5, p 359-364, May 1988. 7 fig, 1 tab. English Summary.

Descriptors: *Effluents, *Water cooling, *Processs control, *Water quality control, *Water pollution, Cooling, Leakage, Monitoring, Rivers, Techology, Management planning.

One possible way to monitor liquid effluents to improve the safety of river water cooling systems is to control the river water side of the cooling system continuously by process analyzers. In this way, leakages in cooling systems can be recognized earlier and the amount of products which contaminate the river water can be minimized. The available process analyzers are described and reasons for choosing among them are discussed. A second aim is to help him decide which of these analyzers is the best for this measuring problem. (Author's abstract)
W89-01184

PHYTOPLANKTON AND REVERSED EUTROPHICATION IN LAKE MALAREN, CENTRAL SWEDEN, 1965-1983,

National Swedish Environmental Protection Board, Uppsala (Sweden). Environmental Quality Lab.
E. Willen.
British Phycological Journal BJPHJAA, Vol. 22, No. 2, p 193-208, June 1987. 10 fig, 1 tab, 60 ref.

Descriptors: *Lake restoration, *Population dynamics, *Phytoplankton, *Eutrophication, *Lake Malaren, Sweden, Nitrogen, Phosphorus, Fertilizers, Lakes.

Summaries of changes since 1965 in the phytoplankton flora of Lake Malaren, the third largest lake in Sweden, are presented. The phosphorous load was reduced by 90% in the period from 1970-1973 and a fertilizer factory on the lake decreased its nitrogen outlet by 80%. The phosphorous concentrations in the water decreased by up to 40% and the total nitrogen concentration decreased by 50% between 1970 and 1983. But, in one part of the lake, the nitrogen concentration increased by 50% due to drainage from surrounding land and atmospheric deposition. With changes in the ratios of N/P and Si/P as well as the turbidity of the water, there have been drastic alterations in species composition and total phytoplankton biomass. There was a rise in the number of species over the period of study at all times of the year. Colonial species decreased while small and large flagellates of chrysophytes, cryptomonads and dinoflagellates increased. In the most polluted basins, cyanobacterial blooms have halted their peak biomasses or have almost disappeared. At times during the 19 years of the study, the summer phytoplankton communities have been tested to fits of a log-normal distribution, assuming such a distribution to be valid in well-balanced ecosystems. The general trend indicates an increasing adjustment to a log-normal distribution. Phytoplankton changes in the lake are associated with effects known to cause reversed eutrophication, although climatically induced variations may also be identified. (Author's abstract)
W89-01188

WATER POLLUTION CONTROL IN DALLAS-FORT WORTH,
Dallas City Water Utilities Dept., TX.
J. Mirochna.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 9, p 1638-1644, September 1988.

Descriptors: *Water pollution control, *Wastewater treatment, *Dallas, *Fort Worth, Urban areas, Wastewater facilities, Water quality standards, Fish kills, Sludge disposal, Trinity River, Nonpoint pollution sources, Future Planning.

The Dallas-Fort Worth metropolitan area is one of the largest population centers in the U.S. not located on a major waterway. Almost 3 million people are served by 8 regional wastewater treatment plants which can release an average of more than 500 mgd of effluent into the Trinity River, whose flow is sometimes 95% wastewater. To meet tougher requirements while serving a growing population, area utilities are working to improve wastewater discharges by expanding and improving treatment plants, reducing extraneous flow into the plants, and encouraging industries to do their part to reduce toxic or high oxygen-demanding discharges. Fish kills have inspired regional efforts. Wastewater operators are also looking for new ways to manage sludge as stronger requirements are expected; the new requirements include toxic limits on discharges. Dallas is conducting a $350,000 project that is the most comprehensive ecological study ever conducted on the Trinity River. A regional effort is underway to learn more about non-point-source pollution and how to mitigate the effects of urbanization on water quality. While utilities in the Dallas-Fort Worth area are proud of improvements they have helped bring about in the environment, there is work still ahead to meet the unique challenges they face. (Shidler--PTT)
W89-01233

ANAEROBIC TREATMENT OF LEACHATE USING FIXED FILM AND SLUDGE BED SYSTEMS,
National Research Council of Canada, Ottawa (Ontario). Div. of Biological Sciences.
For primary bibliographic entry see Field 5D.
W89-01238

DRAFTING WATER QUALITY AGREEMENTS,
Smith and Schnacke, Cincinnati, OH.
For primary bibliographic entry see Field 6E.
W89-01253

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

GENERAL WATER SUPPLY SYSTEM SIMULATION MODEL: WASP,
Newcastle Univ. (Australia). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W89-00299

MULTICRITERION SELECTION OF WASTEWATER MANAGEMENT ALTERNATIVES,
Arizona Univ., Tucson. School of Renewable Natural Resources.
For primary bibliographic entry see Field 5D.
W89-00300

ISSUES IN RULE BASE DEVELOPMENT,
Kereomel Environmental Systems Analysts, Champaign, IL
J. J. Geselbracht, and D. M. Johnston.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 114, No. 4, p 457-468, July 1988, 3 fig, 15 ref.

Descriptors: *Management planning, *Decision-making, *Water resources management, Information, Systems analysis, Wastewater treatment, Computer programs.

An expert system is an efficient human-computer system designed to produce decisions automatically that normally require the application of both factual and heuristic information by a human expert. Expert systems do not add inherent validity to the decision-making process. They provide, however, the avoidance of errors in solution procedures arising from inexperience, fatigue, overconfidence, and other human factors. Information in expert systems is normally represented by production rules. In the development of an expert system two primary concerns are the development of the set of rules and the logic by which the information is processed to obtain a decision. Several approaches to the elicitation of rules, the logical structuring of rules and uncertainty, and calibration of expert systems are reviewed. Decisions resulting from the application of expert systems are very dependent on the logic structure of the system used. Little evidence exists to guide expert system developers in the selection of these approaches. A typical water resources management problem used as an example is that of wastewater treatment. Starting premises for this problem can typically include information regarding the influent constituents, while decisions about design or operation of a wastewater treatment plant can be concluding premises. (Lantz-PTT)
W89-00305

FECAL COLIFORM FINGERTIP COUNT: A POTENTIAL METHOD FOR EVALUATING THE EFFECTIVENESS OF LOW COST WATER SUPPLY AND SANITATION INITIATIVES,
Leeds Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W89-00379

WATER/WASTEWATER FACILITIES GET BETTER WITH ELECTRONICS,
Groveland Community Services District, CA.
For primary bibliographic entry see Field 5D.
W89-00392

NETWORKING URBAN WATER SUPPLIES IN WEST AFRICA,
Minnesota Univ., St. Paul. Coll. of Forestry.
For primary bibliographic entry see Field 5F.
W89-00419

IMPROVING WATER SUPPLY IN THAILAND,
Waterworks Authority, Bangkok (Thailand).
For primary bibliographic entry see Field 5F.
W89-00422

PROGRAMMING MODEL FOR THE OPTIMAL PLANNING OF WATER SUPPLY SYSTEMS,
Natal Univ., Durban (South Africa). Dept. of Civil Engineering.
J. S. Windsor, and J. T. Kuo.
South African Journal of Science SAJSAR, Vol. 81, No. 8, p 510-514, August 1985. 3 fig, 12 ref.

Descriptors: *Planning, *Water supply, *Water management, *Water conveyance, Long-term planning, Mathematical studies, Model studies, Water distribution.

A general approach to the problem of optimal long-range planning of water supply systems is, with particular emphasis on the staging of trunk-line connections. The algorithm uses time decomposition of the state-space to form a sequence of static optimization subproblems of smaller dimension than the original problem. These are solved individually, and then coordinated at a higher level to account for dynamic interaction between time intervals. The methodology employs mixed-integer programming to determine the optimal allocation of water in space, and dynamic programming to determine the optimal timing, sequencing and sizing of the water supply facilities. The methodology enables a large number of alternative configurations to be considered simultaneously even though they may be at different stages of planning. It is also capable of being enhanced in various ways, for example by interactive programming. In this way the user could display and inspect the alternative configurations generated, then modify, delete or add where appropriate. (Lantz-PTT)
W89-00452

MAXIMALLY INFORMATIVE ENVIRONMENTAL CONTROL POLICIES FOR NATURAL RESOURCE SYSTEMS WITH PROBABILISTIC CONSTRAINTS,
California Polytechnic State Univ., San Luis Obispo. Dept. of Economics.
A. Papakyriazis.
Resource Management and Optimization RMOPDH, Vol. 6, No. 1, p 15-24, December 1987. 20 ref.

Descriptors: *Planning, *Policy making, *Environmental control, *Probabilistic process, Model studies, Mathematical studies, Public policy, Environmental policy.

Various internalization schemes must explicitly recognize that the environmental resource production functions are dynamic, time-varying and involve uncertainty. In addition, environmental control agencies must recognize that realistically environmental quality standards must be formulated in probabilistic terms. Given the specification of environmental externality dynamics and environmental constraints in such terms, time-varying environmental models were extended where the decision-maker wishes to impose a probabilistic constraint. A mechanism to sequentially update estimates as new information becomes available is described. A process of this type is crucial for effective environmental policy. (Lantz-PTT)
W89-00458

RATING SYSTEM FOR A UTILITY REHABILITATION PROGRAM,
Bureau of Engineers, Milwaukee, WI.
R. K. Talwalker.
Public Works PUWOAH, Vol. 118, No. 8, p 77-79, July 1988. 1 tab.

Descriptors: *Management planning, *Classification, Economic aspects, Public policy, Wastewater treatment facilities, Water conveyance, Sewers, Capital costs.

In recent years, the question of establishing priority for capital improvement projects has been debated extensively, using evidence from studies done by several agencies. Among the many decision-making tasks involved in programming for a utility project, one of the most prosaic and time consuming is the selection of criteria for a rating system, for ranking utility construction projects for implementation. Whether it is a new system or upgrading of an old system, the improvements usually involve either repair and rehabilitation of the existing utilities or construction of new utilities. Elements in a rating system evaluation for priority listing are: citizen demand, city commitment, environmental and health hazards, age of utility, street reconstruction, structural condition, hydraulic condition, history of failures, special considerations, deposit or grant-in-aid. (Lantz-PTT)
W89-00467

SETTING THE WATER QUALITY AGENDA: 1988 AND BEYOND,
For primary bibliographic entry see Field 5G.
W89-00505

APPLICATION OF PRINCIPAL COMPONENT ANALYSIS TO LONG-TERM RESERVOIR MANAGEMENT,
Quebec Univ., Montreal. Ecole de Technologie Superieure.
M. Saad, and A. Turgeon.
Water Resources Research WRERAO, Vol. 24, No. 7, p 907-912, July 1988. 3 fig, 4 tab, 27 ref.

Descriptors: *Hydroelectric plants, *Manangement planning, *Reservoir operation, *Computer models, *Principal component analysis, Computer programs, Multireservoir power system, Mathematical models, Trajectories, La Grande River, Quebec, Rivers, Model studies.

Determining the optimal long-term operating policy of a multireservoir power system requires a solution of a stochastic nonlinear programming problem. For small systems the solution can be found by dynamic programming, but for large systems, no direct solution method exists yet, so that one must resort to mathematical manipulations to solve the problem. A very efficient procedure is presented for the case where high correlation exists between the reservoirs' trajectories and hence between the state variables. The procedure consists of performing principal component analysis (PAC) on the trajectories to find a reduced model of the system. The reduced model is then substituted into the operating problem, and the resulting problem is solved by stochastic dynamic programming. The reservoir trajectories on which the PCA is performed can be obtained by solving the operating problem deterministically for a large number of equally likely flow sequences. The results of applying the manipulation to Quebec's La Grande River, which has 5 reservoirs, are reported. (Author's abstract)
W89-00698

OPTIMIZATION MODEL FOR SCREENING MULTIPURPOSE RESERVOIR SYSTEMS,
Utah Univ., Salt Lake City. Dept. of Civil Engineering.
U. Lall, and C. W. Miller.
Water Resources Research WRERAO, Vol. 24, No. 7, p 953-968, July 1988. 5 fig, 6 tab, 15 ref. Utah Division of Water Resources Contract 85-5036 and DOI, Office of Water Resources Research Contract 14-08-0001-1072.

Descriptors: *Multipurpose reservoirs, *Reservoir operation, *Mathematical models, *Optimization models, Computer models, River basins, Reservoirs, Simulation, Algorithms, Hydroelectric power, Irrigation, Municipal water, Water supply systems, Lower Bear River, Utah, Flood control.

An optimization model is presented for selecting among and sizing potential reservoirs on a river basin. The provision of water to meet municipal and industrial, irrigation, and hydropower demands, as well as recreation and flood control at each candidate reservoir site are considered. A compact, nonlinear optimization formulation for the reservoir sizing problem is derived by decomposing the problem into simulation and optimization components. Reservoir storage capacities needed are determined using a modified sequent peak algorithm to simulate monthly reservoir operation. Simulation is also employed to determine optimal sizes for hydropower generators at each site. Similarly, average annual flood control and recreation benefits are determined through simulation. An optimization scheme that considers annual yields for each purpose with specified reliabilities and conservation and flood storage as decision variables is used to integrate these simulations into an optimal screening algorithm. Significant savings in computational and memory requirements over other formulations are offered at the expense of nonlinear functional forms. Applications of the model developed with data from sites on the Lower Bear River (Utah) are presented. (Author's abstract)
W89-00703

IDENTIFYING CRITICAL ISSUES IN RECREATION PLANNING AND MANAGEMENT: IMPROVING THE MANAGEMENT-RESEARCH PARTNERSHIP,
Minnesota Valley National Wildlife Refuge, Bloomington, MN.
J. H. Schomaker, and D. W. Lime.
Water Resources Bulletin WARBAQ, Vol. 24, No. 3, p 593-598, June 1988. 1 tab, 30 ref.

Descriptors: *Resources management, *Management planning, *Planning, *Research priorities, *Recreation demand, *Recreation, Public participation, Rivers, Conference.

Numerous research projects, although conducted with the best intentions, are unsuccessful in solving applied problems. This paper focuses on selecting the appropriate research problem. First, past efforts to identify appropriate problems are discussed. Then an approach used to identify problems is discussed, followed by findings and their implications. The 'nominal group' process is a proven technique to systematically arrive at a consensus about critical information needs in recreation planning and management. Using this process, 41 managers who attended a 1983 conference on river management identified 114 specific information needs grouped under 11 general questions. Clearly, some concerns of administrators are researchable; many are not. However, for the successful application of research to solving problems, researchers and managers must cooperate from the earliest stages of problem formulation to the final stages of data acquisition and interpretation. (Author's abstract)
W89-00873

GRADIENT DYNAMIC PROGRAMMING FOR STOCHASTIC OPTIMAL CONTROL OF MULTIDIMENSIONAL WATER RESOURCES SYSTEMS,
Iowa State Univ., Ames. Dept. of Civil Engineering.
E. Foufoula-Georgiou, and P. K. Kitanidis.
Water Resources Research WRERAO, Vol. 24, No. 8, p 1345-1359, August 1988. 2 fig, 5 tab, 37 ref, 5 append. NSF Grants CEE-8212066 and CEE-8420664.

Descriptors: *Stochastic process, *Reservoir operation, *Dynamic programming, *Model studies, Algorithms, Stochastic models, Probabalistic process, Water conveyance, Water supply, Economic aspects, Cost allocation, Cost analysis, Mathematical equations.

A new computational algorithm is presented for the solution of discrete time linearly constrained stochastic optimal control problems decomposable in stages. The algorithm, designated gradient dynamic programming, is a backward moving stagewise optimization. The main innovations over conventional discrete dynamic programming (DDP) are in the functional representation of the cost-to-go function and the solution of the single-stage problem. The cost-to-go function (assumed to be of requisite smoothness) is approximated within each element defined by the discretization scheme by the lowest-order polynomial which preserves its values and the values of its gradient with respect to the state variables at all nodes of the discretization grid. The improved accuracy of this Hermitian interpolation scheme reduces the problem. At each stage, the optimal control is determined on each node of the discretized state space using a constrained Newton-type optimization procedure that has quadratic rate of convergence. The set of constraints that act as equalities is determined from an active set strategy that converges under lenient convexity requirements. This method of solving the single-stage optimization is much more efficient than the conventional way based on enumeration or iterative methods with linear rate of convergence. Once the optimal control is determined, the cost-to-go function and its gradient with the efficient optimization of stochastic systems whose high dimensionality does not permit solution under the conventional DDP framework and for which successive approximation methods are not directly applicable due to stochasticity. Results for a four-reservoir example are presented. (Author's abstract)
W89-00979

SELECTING A CONTRACT OPERATOR FOR YOUR WATER OR WASTEWATER FACILITY,
Professional Services Group, Inc., Houston, TX.
For primary bibliographic entry see Field 5F.
W89-01100

ANALYTICAL SIMULATION OF WATER SYSTEM CAPACITY RELIABILITY: 1. MODIFIED FREQUENCY-DURATION ANALYSIS,
Case Western Reserve Univ., Cleveland, OH. Dept. of Systems Engineering.
For primary bibliographic entry see Field 5F.
W89-01240

ANALYTICAL SIMULATION OF WATER SYSTEM CAPACITY RELIABILITY: 2. A MARKOV CHAIN APPROACH AND VERIFICATION OF THE MODELS,
Case Western Reserve Univ., Cleveland, OH. Dept. of Systems Engineering.
For primary bibliographic entry see Field 5F.
W89-01241

6B. Evaluation Process

RIVER IMPROVEMENT PLANNING FOR FLOOD PROTECTION IN THE KISO RIVER BASIN UNTIL THE MEIJI ERA, (IN JAPANESE),
Nagoya Inst. of Tech. (Japan). Faculty of Technology.
For primary bibliographic entry see Field 4A.
W89-00204

SEA USE PLANNING IN NORWEGIAN WATERS: NATIONAL AND INTERNATIONAL DIMENSIONS,
Fridtjof Nansen Inst., Lysaker (Norway).
For primary bibliographic entry see Field 6E.
W89-00289

ASSESSING NETWORKED COASTAL ZONE MANAGEMENT PROGRAMS,
Wisconsin Univ.-Madison. Dept. of Urban and Regional Planning.
S. M. Born, and A. H. Miller.
Coastal Management CZMJBF, Vol. 16, No. 3, p 229-243, 1988.

Descriptors: *Coastal management, *Management planning, Planning, Institutions, Networks, Governmental interrelations.

During the early development of the national coastal zone management program there was no federal prescription with regard to how coastal states should proceed in establishing their programs institutionally. At one end of the spectrum was the California model - a new coastal 'superagency' with power not only to plan, but to regulate development. At the other end of the spectrum was an approach which relied on existing agencies and authorities and improved policy development and coordination; this approach was described as 'networking'. Many coastal advocacy groups, academics, and bureaucrats viewed the networked model with skepticism. Lessons learned from experimentation with networked coastal management programs may provide important lessons for other regional land and water resources management efforts. (Author's abstract)
W89-00290

HURRICANE-RELATED MORPHODYNAMICS AND IMPLICATIONS FOR HAZARD MITIGATION, PERDIDO KEY, FLORIDA, U.S.A.,
Maryland Univ., College Park. Dept. of Geography.
G. W. Stone, and J. D. Salmon.
Coastal Management CZMJBF, Vol. 16, No. 3, p 245-270, 1988. 5 fig, 6 tab, 23 ref. Florida Sea Grant R/C-P-10.

Descriptors: *Perdido Key, *Florida, *Planning, *Hurricanes, *Mitigation, Barrier Islands, Hazard planning, Public policy, Government supports, Coastal zone management.

Perdido Key, a transgressive barrier island situated along Northwest Florida, is used to exemplify the importance of prior planning for post-hurricane reconstruction along populated coastal areas. A framework is presented in which nine selected planning criterion (erosion rate setbacks, foredune preservation, hazard zone restrictions, estuarine setbacks, planned unit developments, evacuation planning, vertical evacuation, hazard district taxation, and public participation) are integrated with data describing the morphological response of the barrier to two recent hurricanes - Frederic (1979) and Elena (1985) - prompting the confluence of government and market forces towards a more unified and complete mitigation approach. The 'window of opportunity' concept, is advocated as a necessary approach to enhance mitigative planning via its inception during the short-lived 'launch windows' phase following a destructive hurricane. The general nature of the overall approach discussed allows for its application along other populated coastal areas where the recurrence of hurricanes is an important facet of coastal planning and management. (Author's abstract)
W89-00291

TWINNING: UTILITY PAIRING,
Water and Sewage Authority, Castries (St. Lucia).
For primary bibliographic entry see Field 5F.
W89-00424

UPGRADING WATER SYSTEMS THROUGH PLANNING,
A. R. Gobin.
Public Works PUWOAH, Vol. 119, No. 9, p 71-73, August 1988. 1 fig.

Descriptors: *Regional planning, *Water supply, *Connecticut, Drinking water, Long-term planning, Utilities, Water use, Water law, Regional development, Local governments, State jurisdiction, Interagency cooperation, Water supply development.

The State of Connecticut is addressing drinking-water-supply management by implementing a comprehensive planning process. This process identifies water-system problems and needs in both the short term and long term and then develops plans to address those needs. Water purveyors are required to implement their approved plans and state regulators must consider these plans in their decision-making. Both water suppliers and consumers will ultimately benefit from this ongoing effort to manage the state's water resources wisely and efficiently. A law enacted in 1984 requires water utilities to plan for the provision, protection, and management of sufficient high-quality water supplies to meet existing and future needs. Recognizing that water is a resource unrestricted by political boundaries, it is clear that to maximize efficiency and effectiveness, a regional perspective is necessary. This planning process is designed to bring utility representatives and local officials together to discuss long-range supply issues and to develop an areawide water-supply plan. The state administers the funding for the areawide planning effort and ultimately approves the final project. These coordinated plans are built upon the individual water-system plans of each water utility and modified by regional requirements. The wisdom gained working together through this process is used to solve problems and balance growth with available water supplies. (Shidler-PTT)
W89-00746

STOCHASTIC FORECAST OF WATER LOSSES,
Ohio Univ., Athens. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7B.
W89-00759

COASTAL PLANNING IN THE MORAY FIRTH,
For primary bibliographic entry see Field 2L.
W89-00777

FUTURE PROSPECTS FOR HYDRO ELECTRICITY AND WINDPOWER,
North of Scotland Hydro-Electric Board, Edinburgh.
For primary bibliographic entry see Field 6C.
W89-00793

OTHER FORMS OF ENVIRONMENTAL POLLUTION,
Central Electricity Generating Board, Leatherhead (England). Central Electricity Research Labs.
For primary bibliographic entry see Field 5B.
W89-00794

GEOGRAPHY OF THE ESTUARY AND FIRTH OF CLYDE,
Glasgow Univ. (Scotland). Dept. of Geography.
For primary bibliographic entry see Field 2L.
W89-00798

TECHNOLOGY, INSTITUTIONS, AND SOCIAL GOALS,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
For primary bibliographic entry see Field 6D.
W89-00871

IDENTIFYING CRITICAL ISSUES IN RECREATION PLANNING AND MANAGEMENT: IMPROVING THE MANAGEMENT-RESEARCH PARTNERSHIP,
Minnesota Valley National Wildlife Refuge, Bloomington, MN.
For primary bibliographic entry see Field 6A.
W89-00873

PLANNING INDIANA'S WATER INFRASTRUCTURE FROM A COMPETITIVE PERSPECTIVE,
Purdue Univ., Lafayette, IN. School of Civil Engineering.
M. H. Houck, J. R. Wright, J. T. Diamond, and G. Toft.
Water Resources Bulletin WARBAQ, Vol. 24, No. 3, p 651-659, June 1988. 3 tab, 30 ref.

Descriptors: *Management planning, *Future planning, *Regional planning, *Water treatment facilities, *Wastewater facilities, *Indiana, Water resources development, Economic development, Economic growth, Industrial development.

Indiana has embarked on a program to assess the condition of its infrastructure and to plan for its future. The perspective of this planning differs from the traditional 'master plan' approach--instead, the focus is on competitiveness for economic development. The initial work on the water and sewerage competitiveness of the infrastructure includes: (1) a comparative analysis of the water resources and infrastructure of Indiana and its industrial midwestern neighbors; (2) a technology scan to identify possible technological opportunities that may be important for Indiana; and (3) a set of recommendations for future planning. This work is preliminary in nature but should serve as as starting point for continued strategic planning over the next decade for positioning of Indiana's water and sewerage infrastructure as a key element in the economic growth equation. (Author's abstract)
W89-00880

PETALING JAYA NON-REVENUE WATER CONTROL PROJECT SELANGOR, MALAYSIA,
Jabatan Bekalan Air Selangor, Shah Alam (Malaysia)
For primary bibliographic entry see Field 5F.
W89-00923

WATER CATCHMENT INSTALLATIONS HARMONIZED WITH ECOLOGICAL ASPECTS - AN EXAMPLE IN BERLIN (WEST),
Berliner Wasser-Betriebe Hohenzollerndamm (Germany, F.R.).
H. Tessendorff.
Aqua AQUAAA, No. 3, p 120-126, 1988. 8 fig, 6 ref.

Descriptors: *Berlin, *West Germany, *Artificial recharge, *Groundwater management, Water management, Water supply, Recharge, Groundwater recharge, Planning.

The attempt to balance ecological interests and water supply needs is discussed with regard to the facilities of the Berliner Wasserwerke for artificial groundwater recharge. The groundwater management of the recharge facilities for the Berlin-Spandau area, one of seven production centers in Berlin (West), are examined. It is concluded that water catchment installations and groundwater recharge facilities can have positive effects on flora and fauna. In fact, the recharge project for the water production plant Spandau in Berlin (West) has been awarded a gold medal for excellent integration into the natural landscape by the Federal Minister for Regional Planning, Building and Urban Development (under the auspices of the Federal Republic of Germany). (Miller-PTT)
W89-00926

MARSH MANAGEMENT PLANS IN PRACTICE: DO THEY WORK IN COASTAL LOUISIANA, USA,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 2L.
W89-01060

LOOK TO THE FUTURE: ENVIRONMENTAL EDUCATION,
Texas Univ. at Austin. Dept. of Environmental Health Engineering.
For primary bibliographic entry see Field 5G.
W89-01121

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

FUNDING RESERVE CAPACITY IN WASTEWATER SYSTEMS,
Metropolitan Waste Control Commission, St. Paul,

MN.
For primary bibliographic entry see Field 5D.
W89-00506

DEVELOPER FINANCING OF PUBLIC WASTEWATER SERVICE INFRASTRUCTURE,
For primary bibliographic entry see Field 5D.
W89-00507

FUTURE PROSPECTS FOR HYDRO ELECTRICITY AND WINDPOWER,
North of Scotland Hydro-Electric Board, Edinburgh.
K. R. Vernon.
Proceedings of the Royal Society of Edinburgh (Section B),Vol. 92 (Section B), p 107-117, 1987. 5 fig, 1 tab.

Descriptors: *Scotland, *Hydroelectric power, *Electric power development, *Wind energy, *Resources development, *Water resources development, Economic aspects, Natural resources, Management planning, Pumped storage, Peat, Wave power, Islands.

The large hydro-electric schemes developed by the early 1960s now (1984/85) supply 12% of Scottish electricity demand. The pumped storage schemes contribute to the balance of production and demand but are not net producers of electric power. Schemes remaining for development are numerous but small, in the range below 10 MW. Private development for local use is the best economic prospect for schemes below 500 kW. A rolling five-year program of 10-15 MW per annum is suggested for the development of remaining resources. In Scottish conditions, peat does not appear to be a viable alternative to diesel power. Wave power is practicable, but probable costs are too high to justify investment at present. Wind power is promising, especially for island sites, but not as a complete replacement for diesel. Developments since 1980 include a successful small machine on Fair Isle and machines at 250 and 300 kW on Orkney where a 3 MW generator is being erected. A 750 kW machine has been ordered for Shetland. (See also W89-00775) (Author's abstract)
W89-00793

DO WATER MARKET PRICES APPROPRIATELY MEASURE WATER VALUES,
Arizona Univ., Tucson.
For primary bibliographic entry see Field 6D.
W89-00837

EFFECTS OF RATE STRUCTURE KNOWLEDGE ON HOUSEHOLD WATER USE,
Central Michigan Univ., Mount Pleasant. Dept. of Economics.
For primary bibliographic entry see Field 6D.
W89-00877

OPTIMIZATION OF THE PRODUCTION AND PUMPING COSTS OF THE NICE WATER NETWORK (OPTIMISATION DE LA PRODUCTION ET DES POMPAGES SUR LE RESEAU D'EAU DE NICE),
Compagnie Generale des Eaux, Nice (France).
For primary bibliographic entry see Field 5F.
W89-00922

MANAGEMENT OF A TRIBUTARY AQUIFER,
New Mexico Univ., Albuquerque. Dept. of Economics.
For primary bibliographic entry see Field 4B.
W89-00978

EX POST ANALYSIS OF FLOOD CONTROL: BENEFIT-COST ANALYSIS AND THE VALUE OF INFORMATION,
International Food Policy Research Inst., Washington, DC.
J. Ramirez, W. L. Adamowicz, K. W. Easter, and T. Graham-Tomasi.
Water Resources Research WRERAO, Vol. 24, No. 8, p 1397-1405, August 1988. 3 fig, 10 tab, 19 ref.

Descriptors: *Cost-benefit analysis, *Information value, *Flood control, *Cost analysis, *Economic aspects, Frequency analysis, Decision making, Hydraulic design, Discharge frequency, Project planning, Flood frequency, Case studies.

Two analytical tools which aid decision making in flood control design, ex post benefit-cost analysis and the ex post value of information, are presented for the case study of Rushford, Minnesota. The ex post analysis is conducted using a coincident frequency analysis which provides a more accurate description of discharge rates and flood levels. The ex post benefit-cost analysis shows that the Corps of Engineers substantially underestimated the value of potential property damage. The ex post value of information model provides an analysis of the project sensitivity to stream discharge. In addition, the optimum project size is determined under risk of project destruction. The results illustrate that net benefits are sensitive to changes in discharge information but less sensitive to project size and the risk of project destruction. This leads the authors to recommend more sensitivity analyses on information structures, project size, and the probability of project destruction in ex ante benefit-cost analysis. (Author's abstract)
W89-00983

FINANCING STRATEGIES FOR SMALL SYSTEMS,
Nuveen (John) and Co., Inc. Chicago, IL.
For primary bibliographic entry see Field 5F.
W89-01113

ROLE OF ECONOMIC BENEFITS ANALYSIS IN FUNDING MARINE COMBINED SEWER OVERFLOW PROJECTS - CASE STUDY OF BOSTON HARBOR,
Environmental Protection Agency, Washington, DC.
P. Caulkins, C. Binkley, C. Ruf, and C. Miller.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 7, p 1275-1280, July 1988. 2 fig, 6 tab, 7 ref.

Descriptors: *Combined sewers overflows, *Cost-benefit analysis, *Water pollution prevention, *Boston Harbor, *Storm sewers, *Cost analysis, Benefits, Swimming, Shellfish.

An economic benefit-cost analysis of combined sewer overflow control projects was conducted for four areas in the Boston Harbor. Benefit categories included swimming, swimming-related health effects and shellfishing. A conditional, multinomial logit choice model was used to estimate demand for beach/swimming recreation under differing water quality conditions. Annual values of additional shellfish harvest corresponding to sewer overflow controls were estimated. The health benefit category considered the reduction in the incidence of gastroenteritis per 1000 swimmers. Benefit-cost results proved to be commensurable in three out of the four projects. (Author's abstract)
W89-01132

6D. Water Demand

WATER-MANAGEMENT SIGNIFICANCE OF THE MOSCOW CANAL,
For primary bibliographic entry see Field 3B.
W89-00050

GENERAL WATER SUPPLY SYSTEM SIMULATION MODEL: WASP,
Newcastle Univ. (Australia). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W89-00299

MICROHABITAT USE BY AN ASSEMBLAGE OF CALIFORNIA STREAM FISHES: DEVELOPING CRITERIA FOR INSTREAM FLOW DETERMINATIONS,
California Univ., Davis. Dept. of Wildlife and Fisheries Biology.
P. B. Moyle, and D. M. Baltz.
Transactions of the American Fisheries Society TAFSAI, Vol. 114, No. 5, p 695-704, September 1985. 5 fig, 2 tab, 22 ref. University of California Water Resources Center Project UCAL-WRC-W-573.

Descriptors: *California, *Fish, *Habitats, *Instream flow, Suckers, Squawfish, Hardhead, Roach, Perch, Sculpin, Fish behavior, Trout, Ecosystems.

Microhabitat requirements were determined for eight species of native California stream fishes: rainbow trout Salmo gairdneri; Sacramento sucker Catostomus occidentalis; Sacramento squawfish Ptychocheilus grandis; hardhead Mylopharodon conocephalus; California roach Hesperoleucus symmetricus; speckled dace Rhinichythys osculus; tule perch Hysterocarpus traski; and riffle sculpin Cottus gulosus. Two or three size classes were evaluated for each species. Each species had a preferred microhabitat (defined on the basis of depth, velocity, substrate), as did each size class within each species, but there was much similarity in microhabitat use within and among species. The amount of microhabitat available to each species differed in three stream reaches in which availability was quantified, but the differences were not enough to explain the differences in composition of the fish assemblage found at each site. This study indicates that recommendations for instream flows should be based on microhabitat use data collected on site together with habitat availability data. Even on-site data should be used cautiously because intraspecific interactions and changes in a stream's physical characteristics, especially in its temperature regime, may cause unexpected shifts in microhabitat use. (Author's abstract)
W89-00319

IMPLICATIONS OF PUBLIC OWNERSHIP OF IRRIGATION CANAL SYSTEMS IN THE TEXAS RICE BELT: IMPACTS ON WATER USE AND WATER PRICE,
Texas A and M Univ., College Station. Dept. of Agricultural Economics and Rural Sociology.
For primary bibliographic entry see Field 6E.
W89-00460

HISTORICAL USE OF GROUND WATER IN TERRELL, TEXAS,
IT Corp., Terrell, TX.
For primary bibliographic entry see Field 4B.
W89-00461

DO WATER MARKET PRICES APPROPRIATELY MEASURE WATER VALUES,
Arizona Univ., Tucson.
B. C. Saliba, D. B. Bush, W. E. Martin, and T. C. Brown.
Natural Resources Journal NRJOAB, Vol. 27, No. 3, p 617-651, Summer 1987. 2 fig, 2 tab, 74 ref.

Descriptors: *Water transfer, *Water demand, *Water rates, *Water resources development, Water law, Economic aspects, Water allocation, Market value.

Valuation of changes in water availability is an important issue in the western United States. Agriculture, industry, and expanding urban centers are exerting increasing pressure on limited water resources. Federal, state and local agencies are exploring and implementing a variety of water supply augmentation strategies in the western states, raising questions regarding the value of potential increments or decrements in water supply. Pressures for water transfers exist as water in many regions in fully appropriated and new and expanding uses can be accommodated only through transfer from established uses. In some areas, water is routinely transferred through private market exchanges. In other areas, institutions which govern water allocation slowly are being modified to facilitate market transfer of water rights. Selected water markets in the western United States were

examined observing water prices over time and evaluating the appropriateness of market prices as measures of the economic value of incremental changes in regional water supply. Market characteristics which may distort prices as indicators of water values include imperfect competition, third party effects, uncertainly, and equity considerations. Western water markets exhibit these characteristics to varying degrees. Nonmarket valuation techniques are useful in supplementing price information generated by market transactions. Reliance on both market and nonmarket value information can help improve valuation of incremental increases in water supplies and assist in better policy decisions regarding supply augmentation proposals. (Author's abstract)
W89-00837

TECHNOLOGY, INSTITUTIONS, AND SOCIAL GOALS,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
W. Viessman.
Water Resources Bulletin WARBAQ, Vol. 24, No. 3, p 581-584, June 1988. 3 ref.

Descriptors: *Management planning, *Water management, *Water policy, *Water demand, *Social values, *Institutions, *Technology, Water quality management, Water requirements.

The real factors underlying a perceived water crisis are often overlooked and the solutions prescribed are far from optimal when measured in either economic or social terms. Today's technology outstrips its implementation, yesterday's solutions are imposed on new problems. There is a need for the application of innovative and revolutionary tactics, for modernizing institutions, and for educating technologists and decision makers alike in the art of communicating their views and skills. The key to successful water management is understanding the factors that influence it. These include: social goals, local interests, regional differences, technology, politics, societal attitudes, prevailing problems, the resource base, governmental jurisdictions, organizational structures, financing options, the art of compromise, and the technical-social interface. (Author's abstract)
W89-00871

EFFECTS OF RATE STRUCTURE KNOWLEDGE ON HOUSEHOLD WATER USE,
Central Michigan Univ., Mount Pleasant. Dept. of Economics.
D. E. Agthe, R. B. Billings, and J. M. Dworkin.
Water Resources Bulletin WARBAQ, Vol. 24, No. 3, p 627-630, June 1988. 2 tab, 9 ref.

Descriptors: *Social adjustment, *Water rates, *Domestic water, *Water use, Consumptive use, Public participation, Seasonal variation.

Socioeconomic determinants of individual household water use were estimated using regressions of these characteristics with actual household water use for winter and summer. Results were disaggregated between those consumers who were aware of an increasing block rate price structure and those who were not. Most of the informed group members believed that this price structure did result in significant reductions in water use. Nevertheless, overall water use was greater for the informed group. The determinants of water use were found to differ between informed and uninformed users as well as between winter and summer. The uninformed users were influenced by a larger set of variables in each season than the informed group. In winter, the informed group members with swimming pools and/or arid landscaping used less water than their uninformed counterparts. Summer water use increased with length of tenancy in home for the uninformed group but not for informed, while increasing with ownership for informed consumers. (Author's abstract)
W89-00877

RECREATION RESOURCE ALLOCATION MODEL FOR PUBLIC DRINKING RESERVOIRS,
Massachusetts Univ., Amherst. Dept. of Landscape Architecture.
M. Gross, L. R. Klar, and L. McKean.
Aqua AQUAAA, No. 2, p 81-84, 1988. 2 fig, 9 ref.

Descriptors: *Model studies, *Recreation, *Water quality, *Reservoirs, *Path of pollutants, Public waters, Massachusetts, Drinking water, Carrying capacity.

A management model was developed for determining optimal mixes of recreation activities at public drinking reservoirs. Quabbin Reservoir, located in Central Massachusetts, served as a case study for the model. An interdisciplinary research team was formed to study: (1) the impact of selected recreation activities on the water quality, (2) public demand and willingness to pay for selected recreation activities at Quabbin, and (3) the cost benefits associated with increases in recreation at Quabbin. The results of the research yielded a comprehensive Recreation Resource Allocation Model. The model includes the following procedures: the determination of demand for recreation activity packages, pollution transport modelling and water quality carrying capacity and recreation carrying capacity. These inputs to the optimization of the recreation management model were used to formulate alternative plans which were then tested for their impacts based on the management objectives and constraints of the study. (Author's abstract)
W89-00921

NATIONAL WATER MANAGEMENT IN THE REPUBLIC OF SOUTH AFRICA: TOWARDS A CONSULTATIVE PARTNERSHIP WITH DIVERSE USERS IN A SEMI-ARID COUNTRY,
Department of Water Affairs, Pretoria (South Africa).
A. H. Conley, and D. C. Midgley.
Journal of Hydrology JHYDA7, Vol. 100, No. 1/3, p 473-487, July 30, 1988. 1 fig, 4 ref.

Descriptors: *Water management, *Water demand, *Water use, *Arid lands, *Water quality control, *Water conservation, *South Africa, Water supply, Water allocation, Allocation, Water reuse, Water importing, Water transfer, Industrialization, Urbanization, Wastewater renovation, Groundwater management, Desalination, Irrigation, Powerplants, Forestry, Eutrophication.

A resourceful holistic water management strategy has been developed for ensuring equitable provision of adequate quantities of water of satisfactory quality at acceptable risk and affordable cost to a wide international range of competing user groups subject to adverse physical and hydrological factors and under rapidly changing social conditions. Scarce resource allocation strategies, based on scientific studies and supported by modern data processing facilities, focus primarily on supply, demand and quality. Supply management implies creation of the best combination of affordable elements of infrastructure for bulk water supplies from available runoff, groundwater reuse, imports and unconventional sources, sized to meet determinable requirements with appropriate degrees of assurance, coupled with continuous optimization of system operation. Demand management seeks optimum allocation of available supplies to towns, power generation, industry, mining, agriculture, forestry, recreation and ecology, according to priority criteria determined from scientific, economic and socioeconomic studies. Quality management strategies relate to the control of salination, eutrophication and pollution from both diffuse and point sources. As the combined demands of complex First and Third World societies and economies on the available resources rise, increasing attention has to be paid to finding practical compromises to facilitate handling of conflict between legitimate users having widely divergent interests, aspirations and levels of sophistication. For optimum joint utilization, the central regulating authority is striving to forge a consultative partnership within which to promote, among the widest possible spectrum of users, enlightened understanding of the opportunities and limitations in handling complex international, social, political, legal, economic and financial issues associated with water development. These cannot readily be resolved by the methods of traditional hydrological sciences alone. (Author's abstract)
W89-01029

RISK: A KEY WATER POLICY ISSUE,
Houston Univ. at Clear Lake City, TX. Bureau of Research.
R. C. Allison, R. Durand, and G. Schwebach.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 7, p 1211-1213, July 1988. 13 ref.

Descriptors: *Risks, *Water supply, *Water use, *Decision making, *Water policy, Drinking water, Reclaimed water, Water management, Irrigation water.

Risk management issues associated with the provision of safe and sufficient water supplies (including several points of debate with respect to drinking water, marine and fresh water used for recreation, and reclaimed waste or wastewater used for irrigation) are examined. Those charged with managing risks to drinking water presently lack viral standards on which to base decisions intended to minimize public health problems. There is considerable disagreement over how to measure recreational water pollution and which indicator system and standards should be used. Therefore, it has not been possible to adequately estimate the risks associated with recreational water use. Controversy surrounding the use of reclaimed wastewater has centered around what the best indicator of reuse water quality is, what the standards and guidelines for water quality should be, and what the health effects of reclaimed wastewater for irrigation are. Risk managers face the general problem of not knowing the cause that is likely to produce any desired effect, at least in the short term. The base of the problem is a lack of a commonly agreed upon means of measuring contamination and an inability to tie such measures to specific health and safety outcomes. Risk managers should adopt, in the short run, what has been advocated as a policy for error variance - options for coping with or adjusting to the uncertain or unpredictable. Without an explicit adoption, risk managers, no matter how well intended, may create more risks than they reduce. (Miller-PTT)
W89-01123

6E. Water Law and Institutions

EVALUATION OF LAKE RESTORATION IN SWEDEN,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
For primary bibliographic entry see Field 5G.
W89-00021

EXPERIENCES WITH THE ASSESSMENT OF THE RESIDUAL WATER FLOW IN REGULATED WATER COURSES IN THE SALZBURG REGION (ERFAHRUNGEN BEI DER BEURTEILUNG DER RESTWASSERFUHRUNG VON AUSLEITUNGSSTRECKEN IM LAND SALZBURG),
Amt der Salzburger Landesregierung (Austria). Unterabteilung Wasserbau.
For primary bibliographic entry see Field 4A.
W89-00164

SEA USE PLANNING IN NORWEGIAN WATERS: NATIONAL AND INTERNATIONAL DIMENSIONS,
Fridtjof Nansen Inst., Lysaker (Norway).
S. Andresen, and B. Floistad.
Coastal Management CZMJBF, Vol. 16, No. 3, p 183-200, 1988. 1 tab.

Descriptors: *Oil spills, *Seas, *Norway, *Management planning, *Governmental interrelations, Navigation, Oil, Fuel, Fisheries, Competing use, Water pollution, Economic aspects.

The extent to which governmental authorities on the national and international level have the capacity to deal with the varied and complex manage-

ment tasks in Norwegian waters is addressed. The extension of Norwegian national waters and the increased and more diversified use of these areas may have intensified the need for sea-use planning. Often, the study of sea-use planning seems to be synonymous with the study of the ocean areas fairly close to the coast. In many ways this seems natural, since these are the areas where inter-use conflicts tend to be most abundant. The focus is on national and international levels, rather than on local or regional. Given this qualification, the following three sectors have been chosen as the empirical foci for the study: oil and gas, fisheries, and marine pollution. It may be surprising to some that shipping and transportation are excluded, because Norway still is a fairly large shipping nation. However, 90% of Norwegian ships never enter a Norwegian port and shipping or transportation does not seem to have caused any significant problems nationally or internationally in Norwegian waters from a sea planning perspective. The intensity of the inter-use conflicts among the three sectors in question within the Norwegian economic zone, was examined. On that basis an assessment was made as to whether the proper solutions have been applied by the responsible authorities to mitigate these conflicts. On the international level, the main question addressed was whether the interests of other nations have been considered as decision premises in the management of Norwegian ocean areas, and the level of coordination between the responsible Norwegian ministries in their dealings with other countries. (Lantz-PTT)
W89-00289

ASSESSING NETWORKED COASTAL ZONE MANAGEMENT PROGRAMS,
Wisconsin Univ.-Madison. Dept. of Urban and Regional Planning.
For primary bibliographic entry see Field 6B.
W89-00290

IMPLICATIONS OF PUBLIC OWNERSHIP OF IRRIGATION CANAL SYSTEMS IN THE TEXAS RICE BELT: IMPACTS ON WATER USE AND WATER PRICE,
Texas A and M Univ., College Station. Dept. of Agricultural Economics and Rural Sociology.
J. K. Harper, and J. W. Mjelde.
Resource Management and Optimization RMOPDH, Vol. 6, No. 1, p 45-58, December 1987. 1 fig, 3 tab, 17 ref.

Descriptors: *Public waters, *Rice, *Water use, *Costs, *Irrigation canals, Economic aspects, Texas, Irrigation water, Water costs.

An analysis of the implications of public ownership on rice irrigation water use and water price in the Texas Rice Belt was conducted. The analysis tested the hypotheses that the form of ownership has no effect on water use patterns and water price per acre. Results indicate that the form of ownership has a significant impact on irrigation water use per acre and on water price per acre. The change of canal systems from private to public ownership has on average increased water use per acre. Further, publicly owned canal systems charge less per acre for first crop rice irrigation water than privately owned canal systems. No significant difference in second crop rice irrigation water price was found between the publicly owned and privately owned canal systems. (Author's abstract)
W89-00460

CITIZEN SUITS UNDER THE CLEAN WATER ACT: WAITING FOR GODOT IN THE FIFTH CIRCUIT,
S. Elliot.
Tulane Law Review, Vol. 62, No. 1, p 175-206, November 1987.

Descriptors: *Legal aspects, *Water pollution prevention, *Water law, *Judicial decisions, Clean Water Act, Legislation, Federal jurisdiction.

The decision of Hamker v. Diamond Shamrock Chemical Co. in the Fifth Circuit highlights the difficulties posed by divergences in the circuit's interpretation of national laws for pollution prevention. The issue facing the panel in Hamker was whether it should affirm the dismissal of the citizen suit brought to enforce the Clean Water Act for lack of subject matter jurisdiction on the ground that the plaintiff alleged only a single prior violation and no ongoing violations. The Fifth Circuit, in affirming the court below, so narrowly read the language, structure, and legislative history of the Clean Water Act that it has created an inability to effectively bring citizen suits under the Clean Water Act. (Author's abstract)
W89-00517

TOXIC AND ENVIRONMENTAL TORTS WITHIN ADMIRALTY,
Hunton and Williams, Norfolk, VA.
R. M. Hughes, and D. A. Kelsey.
Tulane Law Review, Vol. 62, No. 2 & 3, p 405-431, February 1988.

Descriptors: *Environmental effects, *Toxicity, *Legal aspects, *Oil pollution, *Marine environment, *Torts, *Law of the Sea, Liability, Maritime law, State jurisdiction.

The principal forms of maritime law governing toxic and environmental liability are surveyed. Products liability action refers to a claim against a manufacturer or subsequent distribution based on the unreasonably dangerous nature of the product, rather than on the methods of the product's transportation or stowage. Historically, the admiralty courts have tried to balance state tort law and federal legislative solutions. The most serious environmental torts within the admiralty courts typically involve oil pollution resulting from an accidental spill from a vessel. The Federal Water Pollution Control Act, or Clean Water Act, governs the vessel's liability for removal costs and civil penalties, but does not imply a private course of action. The general maritime law provides a negligence cause of action for parties with a strong relationship to the navigable waters. (Hammond-PTT)
W89-00518

HAZARDOUS AND NOXIOUS SUBSTANCES,
For primary bibliographic entry see Field 5G.
W89-00519

INTERNATIONAL CONTROL OF CROSS-MEDIA POLLUTION: AN ECOSYSTEM APPROACH,
Fordham Univ., Bronx, NY. School of Law.
For primary bibliographic entry see Field 5G.
W89-00520

GLOBAL ENVIRONMENT: A PROPOSAL TO ELIMINATE MARINE OIL POLLUTION,
Texas Univ. at Austin. School of Law.
For primary bibliographic entry see Field 5G.
W89-00521

SIERRA CLUB V. BLOCK, WILDERNESS WATER RIGHTS PROTECTED WHERE NOT IN CONFLICT WITH PURPOSES OF NATIONAL FOREST IN COLORADO,
H. W. Dangler.
Natural Resources Journal NRJOAB, Vol. 27, No. 2, p 441-456, Spring 1987.

Descriptors: *Legal aspects, *Water law, *Wilderness areas, *Watershed management, Federal jurisdiction, State Jurisdiction, Legislation, Water rights, United States.

The Wilderness Act of 1964 created a framework for Congress to designate lands within the national forest system as wilderness areas. The significance of Sierra Club v. Block lies in its extension of federal reserved water rights to wilderness areas. If upheld, the federal reserved right will place a new restriction on western states' control over their watersheds. The degree to which this holding will affect decisions in other western states depends primarily on how successfully the Sierra opinion distinguished United States v. New Mexico. In its effort to reach a compromise between apparently inconsistent Congressional purposes, the Sierra court qualified its own conclusion that Congress, when it passed the Wilderness Act, intended a second withdrawal and reservation of lands. By mixing issues of competing interests with an analysis of Congressional intent, the Sierra opinion may have diluted the federal reserved water rights doctrine as an instrument of federal rights. (Hammond-PTT)
W89-00522

REGULATION OF POLLUTION: CONTROLS AND RESPONSIBILITIES,
Highland River Purification Board, Dingwall (Scotland).
D. Buchanan.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 91, p 283-288, 1986.

Descriptors: *Moray Firth, *Water law, *Legal aspects, *Scotland, *Administrative agencies, *Water pollution control, *Coastal waters, Estuaries, Rivers, Groundwater pollution, Oil pollution, Ocean dumping, Waste disposal.

The most pertinent sources of pollution in Moray Firth (Scotland) are considered to be direct discharges of sewage and trade effluent through public sewers; discharges to underground strata; the deposit of waste on land and at sea, and oil discharge from shore and offshore installations and vessels. The distribution of the main function and responsibilities for the administrative control of pollution and the concomitant statutory powers are explained according to the sources of pollution for which each is responsible. (See also W89-00775) (Author's abstract)
W89-00786

CONSERVATION OF NATURAL RESOURCES,
Nature Conservancy Council, Edinburgh (Scotland).
A. J. Kerr.
Proceedings of the Royal Society of Edinburgh (Section B), Vol. 90, p 469-478, 1986. 2 fig, 21 ref, append.

Descriptors: *Clyde Estuary, *Firth of Clyde, *Coastal waters, *Economic aspects, *Scotland, *Legal aspects, Political aspects, Water law, Estuaries, Regional planning, Wastewater disposal, Recreation, Tourism.

The Clyde Estuary is important for economic, scientific and aesthetic purposes. In the economic sphere, two nuclear and one oil-fired power generation stations are operated on the Clyde; the estuary is also used for the disposal of treated sewage and sewage sludge, by commercial fishermen, and as a tourist site. The estuary has been the focal point of numerous research studies by universities, research institutes and industrial organization. The estuary is an important recreational resources but very few statistics are available on this point. The World Conservation Strategy has the goal of achieving the integration of conservation and development. The conservation and Development Program for the U.K., which was prepared in response to the WCS call for action, concludes that the achievement of the objectives of the WCS will depend on action by a number of groups, including the central government, industry, the Strathclyde Region, and the Planning Department of the District Council on the coast of the estuary. (Alexander-PTT)
W89-00827

SURVEY OF THE INTERNATIONAL LAW OF RIVERS,
Denver Univ., CO. Coll. of Law.
J. O. Moermond, and E. Shirley.
Denver Journal of International Law and Policy, Vol. 16, No. 1, p 139-159, Fall 1987. 128 ref.

Descriptors: *Legal aspects, *Water law, *Rivers, Political aspects, Riparian rights, Water rights.

The principles that appear to be followed by the international community are no substantial harm

and equitable utilization, and possibly optimum use of rivers. Although the principle of no substantial harm provides a definition of what is a legal river use, the principle does not provide standards for judging the legality of a river use or for reaching an equitable resolution of a river dispute. The principle of equitable utilization, on the other hand, does provide usable standards for resolving a river dispute. This is not to say the principle of no substantial harm is of no significance. The principle of equitable utilization embodies the no substantial harm principle along with many other factors. In some cases the harm caused to a riparian by the river use of another riparian may be so great that under either the principle of equitable utilization or the principle of no substantial harm the use may be prohibited. However, it is when the degree of harm is not so severe that the principle of equitable utilization is clearly more useful to resolving disputes. This is because the principle of equitable utilization, unlike the principle of no substantial harm, provides equitable standards by which all river disputes may be resolved. (Alexander-PTT)
W89-00835

POLITICS OF HYDRO-MEGAPROJECTS: DAMMING WITH FAINT PRAISE IN AUSTRALIA, NEW ZEALAND, AND BRITISH COLUMBIA,
Victoria Univ. (British Columbia). Dept. of Geography.
W. R. D. Sewell.
Natural Resources Journal NRJOAB, Vol. 27, No. 3, p 497-532, Summer 1987. 8 fig, 3 tab, 93 ref.

Descriptors: *Australia, *New Zealand, *British Columbia, *Dams, *Water resources development, *Hydroelectric plant, *Political aspects, *Legal aspects, Public policy, Electric powerplants, Conservation, Water law.

Bitter confrontations have occurred in northern Canada, Australia and New Zealand over proposals for hydro-power development. The history of three hydropower projects that were proposed in the 1970s is examined. One of these was the Franklin Dam, scheduled for construction in Southwest Tasmania, Australia, in the last remaining extensive wilderness area in that country. A bitter conflict arose between the Tasmania Hydroelectric Commission and a coalition of environmentalists, ending eventually with the intervention of the Australian Commonwealth government. A second case was the Clyde Dam on the South Island of New Zealand. It was one of a series of 'Think Big' projects put forward by the New Zealand government. The proposal pitted the New Zealand Electricity Department against a variety of well-organized environmental groups from all over the country. The confrontation in this instance too was bitter and protracted. It also led to action in the courts. The third proposal concerned the Site C Project on the Peace River in British Columbia. Here, B. C. Hydro, a large electric power utility was confronted by a coalition of two highly articulate environmental interest groups who contested the need for the scheme, and who drew attention to the damages it would create. In megaproject development confrontation is likely to be increasingly the norm. The conservationists succeeded in preventing the construction of the Franklin Dam but the Clyde Dam is being constructed. The B.C. Hydro project is being held up while trying to find a buyer for its output but not because of the environmental protests. It seems unlikely that compromises will be reached between the advocates of large hydro projects and environmental conservation groups unless there are major changes in existing institutions, particularly laws, policies, and evaluation procedures. (Alexander-PTT)
W89-00836

GROUNDWATER RIGHTS: DEFINITION AND TRANSFER,
Clark Univ., Worcester, MA. Graduate School of Geography.
J. L. Emel.
Natural Resources Journal NRJOAB, Vol. 27, No. 3, p 653-673, Summer 1987. 5 fig, 63 ref.

Descriptors: *Water rights, *Groundwater management, *Water resources development, *Model studies, *Water law, Economic aspects, Political aspects, Legal aspects.

Two major goals of groundwater supply management that must be made operational to mitigate the problems of development rate and pumping externality are property rights protection and aquifer development management. It is shown that criteria and modelling can provide a right definition that accomplishes the two goals. A definition of a property right in groundwater is proposed that is enforceable, meets aquifer development projects, and is transferable. This water right is: (1) the amounts of water historically pumped or consumptively diverted that (2) in transfer to a new owner or location is limited by the allowable cumulative well interference and the allowable rate of nonpumping water level decline. (Alexander-PTT)
W89-00838

CLEAN AIR ACT-TRANSBOUNDARY ACID RAIN POLLUTION ABATEMENT-ADMINISTRATIVE DISCRETION CITIZEN SUIT,
For primary bibliographic entry see Field 5G.
W89-00839

TIDAL POWER RUFFLES FEATHERS,
For primary bibliographic entry see Field 8A.
W89-00850

TECHNOLOGY, INSTITUTIONS, AND SOCIAL GOALS,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
For primary bibliographic entry see Field 6D.
W89-00871

CATALYST FOR REGIONALIZATION OF RURAL WATER SYSTEMS,
Louisville Univ., KY. Dept. of Civil Engineering.
C. E. Miller, and L. Hamilton.
Water Resources Bulletin WARBAQ, Vol. 24, No. 3, p 677-684, June 1988. 4 fig, 4 tab, 17 ref.

Descriptors: *Rural areas, *Water districts, *Hydraulic models, *Regional planning, Data processing, Networks, Water conveyance, Computer programs.

The National Regulatory Research Institute has recommended the merger of small rural water districts in the United States. Success at bringing about merger of these districts, which contain fewer than 3500 customers, has been highly limited. The subject of this paper is a demonstration project that may act as a catalyst to achieve the desired goal of regionalization. A computerized hydraulic data management program was developed for a case study in Nelson County, Kentucky. University professors, graduate students, and two water utilities' staffs cooperated in network analysis employing computer hardware and software. The utilities' staffs were taught the science and technology of hydraulic model preparation, simulation, and analysis for the case study distribution systems. As an integrated system, the model contained 294 pipes, 234 nodes, six pumps, and 11 tanks. Each utility's problem areas were identified and some of the individual and mutual benefits of hydraulic planning were illustrated. A dialogue resulted between the managers. Each manager described his goals and agreed that, although political merger was not feasible at the present time, future economic factors could be a definite influence in reversing that decision. (Author's abstract)
W89-00883

REGULATED RIVERS IN THE UNITED KINGDOM,
Loughborough Univ. of Technology (England). Dept. of Geography.
For primary bibliographic entry see Field 4A.
W89-00948

RIVER REGULATION IN THE UNITED KINGDOM: AN HISTORICAL PERSPECTIVE,
Institute of Terrestrial Ecology, Huntingdon (England). Monks Wood Experimental Station.
For primary bibliographic entry see Field 4A.
W89-00949

RIVER REGULATION: A REGIONAL PERSPECTIVE - NORTHUMBRIAN WATER AUTHORITY,
Northumbrian Water Authority, Gosforth (England).
For primary bibliographic entry see Field 4A.
W89-00950

REGULATION OF THE RIVER DEE,
Welsh Water Authority, Powys.
For primary bibliographic entry see Field 4A.
W89-00953

OUTSTANDING PROBLEMS IN RIVER REGULATION,
Severn-Trent Water Authority, Birmingham (England).
For primary bibliographic entry see Field 4A.
W89-00963

PROBLEM WITH NITRATES,
For primary bibliographic entry see Field 5B.
W89-00965

WATER RIGHTS: ENFORCING THE FEDERAL-INDIAN TRUST AFTER NEVADA V. UNITED STATES,
R. Florio.
American Indian Law Review, Vol. 13, No. 1, p 79-98, 1987.

Descriptors: *Water law, *Water rights, *Indian water rights, *Nevada v. United States, *Judicial decisions, Reservation doctrine, Enforcement, Appropriation, Winters Doctrine.

In Nevada v United States (1983) the Supreme Court denied the Paiute Indians' request for enough reserved water to maintain the viability of Pyramid Lake and the Truckee River as fish-spawning grounds. Referring to the Orr Ditch case (1944) which fixed the quantity of the Paiutes' reserved right, the Court decided that the government had already litigated on behalf of the Indians and, therefore, the Indians could not relitigate on their own behalf in spite of evidence that the previous award was deficient. The Court went further than was necessary, however, in holding that the United States cannot be held to the fiduciary standards of the Seminole Nation case (1942) where it represents conflicting interests. The Nevada case may mean that tribes who have suffered from inadequate government representation will not be able to recover for the resultant injury where the government also represented competing non-Indian interests. The Nevada decision may also adversely affect the tribes whose water rights were adjudicated in Arizona v. California (1983), which allowed the tribes to sue the government for inadequate representation of their interests. The Nevada decision should be restrictively applied by the lower courts so that Indian as well as non-Indian interests are protected; it should apply only where a tribe seeks to reopen a prior decree. Where tribal water rights are litigated in the first instance, the private fiduciary standard should govern. A second way to mitigate the impact of Nevada is by narrowly defining the conflict of interest situation to which it applies. (Cassar-PTT)
W89-01010

ONCE AND FUTURE EXPERIENCE OF THE CALIFORNIA COASTAL CONSERVANCY,
California State Coastal Conservancy, Oakland.
P. Grenell.
Coastal Management CZMJBF, Vol. 16, No. 1, p 13-20, 1988. 11 ref.

Descriptors: *Conservation, *California, *Coastal zone management, *Legislation, *Natural resources, *Land management, *Wetlands, Urban planning, Land acquisition, Watershed manage-

ment, Environmental Policy, Legal aspects, Parks, Environmental control, Regulations, State jurisdiction.

The activities of the California State Coastal Conservancy are described. Examples of the Conservany's methods are discussed and include: dispute resolutions, technical assistance, land acquisition methods, and watershed restoration and management. Factors critical to the success of the conservancy include California's relatively high degree of 'environmental consciousness,' its great flexibility of action, adequate funding (by general obligation bonds), the existence of the Coastal Commission and its regulatory authority, and the support of the California legislature. (Stoehr-PTT)
W89-01067

CALIFORNIA TAHOE CONSERVANCY: APPLYING THE PRINCIPLES,
California Tahoe Conservancy, Lake Tahoe.
D. T. Machida, and J. B. Gussman.
Coastal Management CZMJBF, Vol. 16, No. 1, p 39-46, 1988. 17 ref.

Descriptors: *Conservation, *Lake Tahoe, *California, *Legislation, *Natural resources, *Environmental policy, *Environmental control, Soil erosion, Land use, State jurisdiction, Regulations, Recreation, Wildlife conservation, Land acquisition, Water quality.

The utilization and advantages of the conservancy model at Lake Tahoe and the programs of the California Tahoe Conservancy are discussed. In 1984, the Conservancy was activated by the California Legislature. The conservancy model was adopted because it offered several important advantages. Among these is an orientation toward a broad range of resource protection objectives and a goal of resolving land use conflicts. The Conservancy's acquisition and restoration programs are unique because of their special focus on water quality objectives. The agency is implementing new programs for the transfer of development rights in the Lake Tahoe Basin. (Author's abstract)
W89-01068

WETLAND PROJECTS OF THE CALIFORNIA STATE COASTAL CONSERVANCY: AN ASSESSMENT,
Zentner and Zentner, San Francisco, CA.
J. Zentner.
Coastal Management CZMJBF, Vol. 16, No. 1, p 47-67, 1988. 8 fig, 47 ref.

Descriptors: *Land use, *Wetlands, *California, *Coastal management, *Land management, *Conservation, *Legislation, Environmental control, Environmental policy, Water pollution, Water quality, Coastal engineering, Land acquisiton, Urbanplanning, Regulations, Legal aspects, Public policy.

Since 1978, the California State Coastal Conservancy's Enhancement Program funded 23 projects and plans affecting 2,328 wetland acres for almost 4 million dollars. Twelve of the projects created, restored, or enhanced wetlands. These projects were evaluated with reference to their functional and perceived success. Ten of the projects were conflict-resolution or land-management plans. These projects were evaluated based on their specific goals. The results of this analysis concluded that the Enhancement Program projects were relatively successful. The success of the wetland creation projects was a result of sound engineering practices. Unsuccessful projects generally were overly complex or lacked appropriate engineering. The success of the plans was a result of the staff's innovative solutions, perseverance, and the unique powers of the Conservancy. Unsuccessful plans were typically overambitious and required intensive management by Conservancy staff. (Author's abstract)
W89-01069

PROSPECTS FOR TRANSFER OF THE CALIFORNIA COASTAL CONSERVANCY MODEL FOR HABITAT RESTORATION TO OTHER COASTAL STATES,
McCreary (Scott), Cambridge, MA.
S. McCreary, and M. Adams.
Coastal Management CZMJBF, Vol. 16, No. 1, p 69-91, 1988. 1 tab, 28 ref.

Descriptors: *California, *Literature review, *Conservation, *Environmental control, *Environmental policy, *Regulations, *Coastal zone management, *Land management, Land use, Watersheds, Wetlands, Streams, Land acquisition, Policy making, Water quality, Habitats, Models studies.

California's Coastal Conservancy has a unique mandate that goes beyond traditional regulatory functions to repair ecological damage to wetlands, streams, and coastal watersheds. Based on extensive interviews and review of the literature, the prospects for transferring or adapting the Conservancy model to three other coastal states: New Jersey, New York, and Massachusetts are considered. Unmet wetlands management needs that a Conservancy could fulfill and major obstacles that could block creation of such a bureau are indentified, and ways to overcome these obstacles and proceed with state sponsored programs of habitat restoration are suggested. (Author's abstract)
W89-01070

COASTAL MANAGEMENT ISSUES FOR THE MOUTH OF THE RIVER MURRAY, SOUTH AUSTRALIA,
South Australia Dept. of Environment and Planning, Adelaide.
N. Harvey.
Coastal Management CZMJBF, Vol. 16, No. 2, p 139-149, 1988. 1 fig, 28 ref.

Descriptors: *Coastal zone management, *Australia, *Policy making, *Jurisdiction, *Land management, Water resources development, Conservation, Rivers, Legislation.

Management issues relating to the potential closure of the mouth of Australia's largest river are examined. The importance of maintaining the river mouth is outlined, together with the implications of restricted river flow and the management response following the most recent closure of the mouth in 1981. One of the major unresolved issues is the question of responsibility and funding, which has arisen because of overlapping jurisdictions on either side of the river mouth and a lack of jurisdiction for the mouth itself, which is an administrative boundary. (Author's abstract)
W89-01072

INTERJURISDICTIONAL MANAGEMENT IN CHESAPEAKE BAY FISHERIES,
Northern Arizona Univ., Flagstaff. Dept. of Political Science.
S. J. B. Cox.
Coastal Management CZMJBF, Vol. 16, No. 2, p 151-166, 1988. 74 ref.

Descriptors: *Jurisdiction, *Chesapeake Bay, *Fisheries, *Coastal zone management, *Political aspects, *Maryland, *Virgina, *District of Columbia, Natural resources, Legislation, Policy making.

Despite severe problems with fisheries stocks in the Chesapeake Bay, no coherent fisheries management policy has developed in the Bay. The high-water mark probably came in 1984-1985, when a bi-state fisheries advisory group had a brief revitalization. This lack of coherent policy raises three questions: 1. Is there a need for unified fisheries management policy in the Bay. 2. How might such a policy be achieved. 3. Can this discussion be generalized to other multijurisdictional management problems. These questions are addressed in three parts. First, the political and biological environment of the Bay is described, followed by a history of intergovernmental relations in the Bay fisheries. The development and subsequent demise of the Fisheries Advisory Group is analyzed, and arguments for and against a unified policy are elaborated. The relationship between organizational structure and organizational function is discussed. Contemporary efforts to address institutional problems are hampered by lack of a theoretical basis for dealing with the problems of the Bay fisheries and the absence of a perceived need for a cooperative fisheries policy among the states sharing the Bay. (Stoehr-PTT)
W89-01073

ROLE OF THE STATES IN SOLVING THE SMALL SYSTEM DILEMMA,
Miller (Wade) Associates, Inc., Arlington, VA.
G. W. Miller, J. E. Cromwell, and F. A. Marrocco.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 8, p 32-37, August 1988. 1 fig, 14 ref.

Descriptors: *Enforcement, *Water treatment, Small water systems, Safe Drinking Water Act, State jurisdiction, Water quality, Standards, Drinking water, Costs, Water pollution sources, Microorganisms, Corrosion control, Lead, Radon, Planning, Financing, Training, Regulations.

Although the problem of bringing small water systems into compliance with the 1986 amendments to the Safe Drinking Water Act seems overwhelming, state governments are in a good position to facilitate and influence the solution to this dilemma. State drinking water regulators can give planning, technical, and financial assistance to small utilities, interact with public utility commissions; coordinate the activities of other water-related state agencies; motivate private investors; and reinforce financial assistance programs. Solving the small system dilemma will require substantial support from the federal government, professional organizations such as the American Water Works Association, and the private sector. (Author's abstract)
W89-01111

SDWA AMENDMENTS: SMALL COMMUNITY COMPLIANCE,
Black and Veatch, Kansas City, MO.
B. W. Long, and J. R. Stukenberg.
Journal of the American Water Works Association JAWWA5, Vol. 80, No. 8, p 38-39, August 1988.

Descriptors: *Management planning, *Water treatment, *Small water systems, *Safe Drinking Water Act, Water quality, Standards, Drinking water, Costs, Microorganisms, Disinfection, Filtration, Water quality control, Regulations, Economic aspects.

The 1986 amendments to the Safe Drinking Water Act will substantially affect the treatment and supply of drinking water, with special problems for small community systems. In all cases, costs will increase for utilities and their customers. For small systems not currently filtering their water, options are as follows: protect the source water quality, take the steps required for a filtration variance, select alternative water sources, improve disinfection practices, and discontinue treatment operation and purchase finished water or arrange for direct service from a neighboring water company. For small systems currently filtering their supplies, options are the same for nonfiltering systems with the addition of the following: improve treatment process effectiveness and adjust disinfection procedures. Resources for small water systems are state personnel, the American Water Works Association state sections, and consulting engineers. (Cassar-PTT)
W89-01112

FINANCING STRATEGIES FOR SMALL SYSTEMS,
Nuveen (John) and Co., Inc. Chicago, IL.
For primary bibliographic entry see Field 5F.
W89-01113

AWWA SMALL SYSTEMS PROGRAM,
American Water Works Association, Denver, CO.
For primary bibliographic entry see Field 5F.
W89-01114

RURAL COMMUNITY ASSISTANCE PROGRAM,
Rural Community Assistance Corp., Sacramento, CA.
For primary bibliographic entry see Field 5F.
W89-01115

DIFFUSE (NONPOINT) POLLUTION - A POLITICAL, INSTITUTIONAL, AND FISCAL PROBLEM,
Marquette Univ., Milwaukee, WI. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W89-01134

RESTORATION OF WETLANDS UNDER SECTION 404 OF THE CLEAN WATER ACT: AN ANALYTICAL SYNTHESIS OF STATUTORY AND CASE LAW PRINCIPLES,
M. C. Rouvalis.
Boston College Environmental Affairs Law Review BCERDX, Vol. 15, No. 2, p 295-347, Winter 1988. 317 ref.

Descriptors: *Clean Water Act, *Environmental policy, *Enforcement, *Wetlands, Legal aspects, Water law, Remedies.

The federal government's use of section 404 of the Clean Water Act as its primary method of protecting the nation's wetlands is discussed. One of the ways in which the government has been enforcing the statutory prohibition against the unauthorized discharge of dredge of fill materials is to request that courts order restoration of sites approximately to their natural condition. In deciding whether to order restoration, courts have frequently used a traditional equitable balancing process. In particular, many courts have adopted the three principle standards articulated in United States versus Weisman to determine the appropriateness of the restoration remedy. The Weisman test instructs courts to impose restoration if the plan (1) confers maximum environmental benefits, (2) is feasible as a practical matter, and (3) bears an equitable relationship to the degree and kind of wrong intended to be remedied by the proposal. Courts have not used these standards, however, to promote the environmental purposes and objectives of the Clean Water Act as effectively as possible. The Weisman requirements provide courts with too much discretion to create orders that undermine the attempt to confer maximum environmental benefits. The objective of any equitable balancing process involved in section 404 violation cases should be to effectuate an environmentally principled reading of that section and the statute as a whole. To further that end, courts should discuss explicitly several issues that should tend to tip the balance in favor of ordering restoration of unlawfully destroyed wetlands. These considerations include deferring to the government to prosecute by not remanding the issue to the agency, conferring maximum environmental benefits, remedying the violation so as to vindicate statutory purposes and the public interest, and designing a remedy that promotes the concept of deterrence. If the courts give proper attention to these elements, courts will promote more substantially the environmental purposes of the act. (Miller-PTT)
W89-01189

CITIES SUPPORTED BY STICKS IN THE MUD: A VARIATION ON THE SETTLEMENT OF LAND AND STRUCTURES CAUSED BY GROUND WATER REMOVAL,
S. M. Kincaid.
Boston College Environmental Affairs Law Review BCERDX, Vol. 15, No. 2, p 249-384, Winter 1988. 252 ref.

Descriptors: *Piles, *Susidence, *Land subsidence, *Foundation failure, *Environmental policy, *Legal aspects, *Water law, Groundwater, Groundwater depletion, Structural settlement, Water rights, Competing use.

The settlement of structures resting on wood piles that have decayed as a result of ground water loss provides an example of a settlement problem that Boston and other older, coastal cities will have to address in the next several years. A landowner's right to ground water that prevents the decay of an artificial support system involves the interplay of support and ground water law. When artificial additions such as subsurface wooden piles are present, support law analysis culminates in holding defendant water-users either to a negligence standard of due care in making withdrawals or to a strict liability standard under the line of cases that first determine whether the improvement itself contributed to its own injury. Either way, support law analysis rests on characterizing decay of the piles as a failure of water to provide support. The need for water to prevent decay of subsurface wooden piles is also usufructory in nature. Rather than depending on the natural presence of water pressure as part of a geological system beneath the land, subsurface wooden piles depend upon water's chemical properties to prevent decay. Thus, the wooden piles' needs become a use of ground water that must compete with other possible uses. Modern ground water law is best able to assign rights and responsibilities among competing users such as building owners dependent upon a subsurface wooden-pile system. Like support law, modern ground water law provides a negligence standard that applies to all parties claiming a need for available ground water. In addition, modern ground water law provides criteria by which courts or a local water protection authority can balance maintaining current levels against other possible beneficial uses and plan for future use or protection of local ground water. (Miller-PTT)
W89-01190

DRAFTING PURCHASE AND SALE AGREEMENTS AFFECTING WATER RIGHTS,
S. E. Clyde.
Natural Resources and Environment, Vol. 3, No. 1, p 5-8, 44-46, Winter 1988.

Descriptors: *Water rights, *Water law, *Contracts, *Legal aspects, Industrial water, Municipal water, Economic aspect.

Procedures and concerns that must be addressed in the drafting of purchase and sale agreements of water rights are discussed. A prudent buyer should ascertain whether a general stream adjudication suit is pending in the particular drainage basin in which this water right originates. The grantor must not guarantee the availability of this quantity of water regardless of precipitation or the assertion of prior rights. The buyer's risks may increase if he desires to change the nature of use from irrigation to domestic or industrial. The purchase price is perhaps the most difficult term to agree on in a water transaction. The value is not the water itself, but the use to which the water can be put. If the parties fail to address price escalation, they could be stuck with an inadequate price forever. Water contracts are not substantially different from real estate contracts and should not cause the practitioner any unnecessary concern or difficulty. The basic real estate contract format should be utilized as it covers most areas of concern in a water rights transaction. (Roseman-PTT)
W89-01252

DRAFTING WATER QUALITY AGREEMENTS,
Smith and Schnacke, Cincinnati, OH.
R. S. Frye.
Natural Resources and Environment, Vol. 3, No. 1, p 25-27, 46-47, Winter 1988.

Descriptors: *Legal aspects, *Water law, *Water quality, *Wastewater treatment, Contracts, Wastewater, Sludge disposal, Environmental aspects, Economic aspects, Liability.

There are numerous types of agreements that relate to the protection or improvement of water quality. The most common type of water quality agreement which a practitioner is likely to encounter is one which relates somehow to the treatment of wastewater prior to discharge. Whether representing a sewage system user (including a municipality that is contracting for sewage treatment services) or a sewage system operator, the practitioner will likely be dealing with four interrelated goals in any water quality agreement. The agreement will need to (1) prevent environmental problems (primarily excessive wastewater discharges or unacceptable impacts from sludge disposal); (2) provide adequate capacity to treat anticipated wastewater loads in the future; (3) allocate capital and operating costs among the parties (perhaps including costs for future expansions or future regulatory compliance costs); and (4) allocate liability among the parties (primarily for adverse environmental impacts or penalties). Any wastewater treatment agreement ought to consider not only liability for future discharges, but liability for past problems as well. (Roseman-PTT)
W89-01253

NEW DIRECTIONS IN NEBRASKA WATER POLICY,
Nebraska Univ.-Lincoln. Dept. of Agricultural Economics.
J. D. Aiken.
Nebraska Law Review, Vol. 66, No. 1, p 8-75, 1987.

Descriptors: *Nebraska, *Water law, *Legal aspects, *Groundwater management, *Environmental policy, *Public policy, Resources management, Water management, Rivers, Endangered species.

The history of water law in Nebraska is discussed and new development are considered. Policies affecting all aspects of water rights, including endangered species, groundwater management, environmental policy and dredge and fill permits, are discussed. The case, Little Blue Natural Resources Dist v. Lower Platte North Natural Resources Dist. (Little Blue I) and its appeal, Little Blue II, are discussed in detail. The judicial reversal of a longstanding prohibition against interbasin surface water transfers led to the Platte River water wars, pitting developer against developer in a major legal battle. The Little Blue Cases would create the policy impasse engendering the Water Independence Congress and LB 1106. This legislative bill is discussed at length. (Roseman-PTT)
W89-01266

STATE EQUITABLE APPORTIONMENT OF WESTERN WATER RESOURCES,
California Univ., Davis.
H. C. Dunning.
Nebraska Law Review, Vol. 66, No. 1, p 76-119, 1987.

Descriptors: *Water law, *Legal aspects, *Resources management, *Groundwater management, *California, Water rights, Riparian rights, Domestic water.

Equitable apportionment is generally thought of as the formula used by the United States Supreme Court to resolve interstate water disputes. The phrase is also familiar in connection with international water resources conflicts. Intrastate controversies, however, are usually decided according to the doctrine of prior appropriation, which in the state law of the West has largely superceded the riparianism of the earlier common law. Priority, not equity, is thus commonly regarded as the paramount consideration when domestic water controversies are decided in the West. Difficulties occur with prior appropriation when in various circumstances juniors with important established uses must be wholly denied water in order to fully honor earlier appropriations. This creates stress for the prior appropriation system, and it sometimes leads to deviation from the priority principle itself. These departures from priority can collectively be regarded as state equitable apportionment of water resources. As time passes and the problems with prior appropriation become ever more apparent, instances of state equitable apportionment are likely to increase in frequency. (Roseman-PTT)
W89-01267

RECURRING STATE JUDICIAL TASK OF CHOOSING RULES FOR GROUNDWATER LAW: HOW OCCULT STILL,
Ohio State Univ., Columbus. Coll. of Law.

E. F. Murphy.
Nebraska Law Review, Vol. 66, No. 1, p 120-144, 1987.

Descriptors: *Groundwater management, *Legal aspects, *Water law, Court decisions, Resources management, Groundwater pollution, Aquifers, Groundwater, Dewatering, Consumptive use.

The history of legal decisions concerning groundwater is discussed. Not until entrepeneurs wanted to dewater the ground for mines or quarries, or mechanically pump previously unknown draft volumes for steam conversion, or cooling, or sale, or other consumptive uses did a natural phenomenon become the human resource of groundwater. At that moment, and no sooner, did the legal system have basic decisions to make among claimants. The history of judicial approaches to groundwater regulation is traced. Increasing knowledge concerning the peculiarities of groundwater, meaning its differences from surface stream flows, accounts for the judicial belief that legal rules can regulate groundwater. Groundwater movement and aquifer flow is discussed, and the problems of groundwater contamination are considered. It is concluded that what is direly needed are legislative actions to locate, allocate, and protect the Nation's groundwater resources. (Roseman-PTT)
W89-01268

CHANGING MEANING OF WATER CONSERVATION IN THE WEST,
Chicago-Kent Coll. of Law, IL.
A. D. Tarlock.
Nebraska Law Review, Vol. 66, No. 1, p 145-174, 1987.

Descriptors: *Water law, *Resources management, *Water conservation, *Economic aspects, Economic efficiency, Conservation, Irrigation, Domestic water, Municipal water, Agricultural water.

Many aspects of water conservation are discussed. Part I examines the law of prior appropriation that developed before what is now refered to as the conservation era. Part II explores the different meanings of water conservation from the progressive era to the present and contrasts these meanings with the concepts of resource conservation and allocation efficiency used by welfare economists. Part III examines existing conservation scenarios with emphasis on efforts to reallocate water through water markets, and discusses changes in the doctrine of prior appropriation that can facilitate the operation of water markets. In the rush to conserve there is a danger that inefficiencies of the past may be compounded. Technical and economic efficiencies must be clearly differentiated. Otherwise, there will be initiatives to require technical, but not economic efficiency at great expense to individual users with no corresponding benefit to society. It is important to recognize that conservation is only one among several choices open to a state deciding how to maximize the value of its water. (Roseman-PTT)
W89-01269

6F. Nonstructural Alternatives

COST EFFICIENCY OF TRANSFERABLE DISCHARGE PERMIT MARKETS FOR CONTROL OF MULTIPLE POLLUTANTS,
Illinois Univ., Urbana. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W89-00697

STATE OF THE ICHTHYOFAUNA IN ISTRINSK RESERVOIR SINCE ITS CONVERSION INTO A RECREATIONAL WATER,
Vserossiiskii Nauchno-Issledovatel'skii Inst. Prudovogo Rybnogo Khozyaistva, Konakovo (USSR).
For primary bibliographic entry see Field 2H.
W89-01191

6G. Ecologic Impact Of Water Development

EFFECT OF SEVERAL METHODS OF AQUATIC PLANT CONTROL ON TWO BILHARZIA-BEARING SNAIL SPECIES,
For primary bibliographic entry see Field 4A.
W89-00117

ROLE OF MARSH PLANTS IN THE TRANSPORT OF NUTRIENTS AS SHOWN BY A QUANTITATIVE MODEL FOR THE FRESHWATER SECTION OF THE ELBE ESTUARY,
Hamburg Univ. (Germany, F.R.). Inst. fuer Hydrobiologie und Fischereiwissenschaft.
For primary bibliographic entry see Field 2L.
W89-00120

GROWTH STRATEGIES AND DISTRIBUTION OF ISOETIDS IN SCOTTISH FRESHWATER LOCHS,
Saint Andrews Univ. (Scotland). Dept. of Plant Biology and Ecology.
For primary bibliographic entry see Field 5C.
W89-00129

DREDGING ACTIVITIES IN THE DUTCH WADDEN SEA: EFFECTS ON MACROBENTHIC INFAUNA,
Nederlands Inst. voor Onderzoek der Zee, Texel.
For primary bibliographic entry see Field 2L.
W89-00151

IMPACT OF IMPOUNDING ON THE OXYGEN BALANCE OF THE DANUBE FROM KELHEIM TO JOCHENSTEIN MICROBIOLOGICAL-BIOCHEMICAL INVESTIGATIONS AND WATER QUALITY MODEL CALCULATIONS (ZUM EINFLUSS DER STRAUREGULIERUNG AUF DEN SAUERSTOFFHAUSHALT DER DONAUSTRECKE KELHEIM-JOCHENSTEIN: MIKROBIOLOGISCH-BIOCHEMISCHE UNTERSUCHUNGEN UND GUTEMODELLRECHNUNGEN),
Bundesanstalt fuer Gewaesserkunde, Koblenz (Germany, F.R.).
D. Muller, and V. Kirchesch.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 68, No. 3/4, p 457-477, May 1987. 11 fig, 22 ref. English summary.

Descriptors: *Danube River, *Dam effects, *Oxygen balance, *Water quality, *Reservoirs, *Algae, *Zooplankton, Simulation analysis, Mathematical models, Navigable rivers, Wastewater facilities, Biological oxygen demand, Ammonium, Flow discharge, Alpine tributaries, Instream flow, Rivers.

Results of microbiological-biochemical investigations of the Danube river, that characterize the different processes influencing the oxygen balance, and results of simulation runs with a water quality model are presented and discussed. The paper describes the impact of the development of the German reach of the Danube between Kelheim and Straubing into a navigable waterway with minimum depth of 3 m needed for modern cargo ships. When considering the oxygen content, the organic load, the algal growth and the additional oxygen consumption for peptone and glucose, the effects of the two impoundments realized so far are superimposed the effects from new wastewater plants, which went into operation during the same period. The mathematical model used is of the deterministic type, calculating the growth of slowly growing organisms (nitrifiers, algae and zooplankters) according to Monod and Michaelis-Menten. The simulation shows that only the impounding of a reach of 90 km (4 impoundments) will result in some significant effects: decrease in C-BOD together with an increasing release of ammonium and enhanced algal growth. In the next river reach downstream the effects are partly compensated. Thus, after the confluence with the river Inn, the Danube reaches Austria with a somewhat enhanced presence of algae and other slowly growing organisms. The slight effects of the impounding of the Danube are compared with the more remarkable effects of impounding in other rivers. In the Danube the change in morphology is small and melting water discharges of the alpine tributaries minimize the problems of low discharge in summer. The methodology of measurement is discussed. In the future the parameters used will be chosen to correspond better to the needs of the quality model used. (Author's abstract)
W89-00173

IMPACTS OF NAVIGATION ON RIVERINE FISH PRODUCTION IN THE UNITED STATES,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Fisheries and Wildlife Sciences.
L. A. Nielsen, R. J. Sheehan, and D. J. Orth.
Polskie Archiwum Hydrobiologii PAHYA2, Vol. 33, No. 3/4, p 277-294, 1986. 2 fig, 5 tab, 49 ref.

Descriptors: *Stream biota, *Navigable Rivers, *Rivers, *Fish populations, *United States, *Navigation effects, *Aquatic habitats, Aquatic animals, Water level fluctuations, Water quality control, Fish, Populations dynamics.

River navigation impacts fish populations through impoundment, operation and maintenance, vessel movement, and associated development. Impoundment created more water area, but has limited fish migration and has intensified siltation. Operation and maintenance causes habitat degradation from dredging, dredged materials disposal, narrowing of the channel and water level fluctuation. Passing vessels cause turbulence and shoreline water movements that can kill fish eggs and larvae. Development of the shoreline also results in habitat loss. Despite these potential problems, fish populations in large U.S. rivers have improved in recent decades because of water pollution abatement and more attention to navigation-fisheries interactions. (Author's abstract)
W89-00248

FISH PRODUCTION IN THE KANAWHA RIVER AND ITS RELATION TO BARGE TRAFFIC,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Fisheries and Wildlife Sciences.
D. C. Hershfeld, D. J. Orth, and L. A. Nielsen.
Polskie Archiwum Hydrobiologii PAHYA2, Vol. 33, No. 3/4, p 295-303, 1986. 2 fig, 2 tab, 10 ref.

Descriptors: *Stream bioat, *Primary productivity, *Rivers, *Navigable rivers, *Barges, *Aquatic habitats, *Fish populations, *Kanawha River, *Navigation effects, Population dynamics, Aquatic animals, Biomass, Water quality control, Fish.

Energy flow was modeled for the Winfield Pool of the Kanawha River in West Virginia, USA, based on field data collected in 1982-1983. Most energy flow depends on detrital sources, with primary production contributing little to eventful fish production. Fish community biomass and production are dominated by herbivore-detritivores, mostly gizzard shad (Dorosoma cepedianum) and small mouth buffalo (Ictiobus bubalus), and by omnivores, mostly common carp (Cyprinus carpio). Simulation of energy flows in the absence of all primary production revealed losses in fish production of 7.5% for herbivore-detritivores and less than 2% for other fish groups. If the only consequence of boat traffic is reduced primary production because of elevated turbidity, then increasing navigational use of the river will cause negligible impacts on fish production. (Author's abstract)
W89-00249

EFFECTS OF DISTURBANCE AND SEVERE SEASONAL FLUCTUATIONS IN ENVIRONMENTAL CONDITIONS ON NORTH TEMPERATE SHALLOW-WATER FISH ASSEMBLAGES,
Oslo Univ. (Norway). Inst. of Marine Biology.
For primary bibliographic entry see Field 2L.
W89-00282

ENDANGERED WOUNDFIN AND WATER MANAGEMENT IN THE VIRGIN RIVER, UTAH, ARIZONA, NEVADA,
Nevada Univ., Las Vegas. Dept. of Biological Sciences.
J. E. Deacon.
Fisheries, Vol. 13, No. 1, p 18-24, January-February 1988. 1 fig, 7 tab, 13 ref.

Descriptors: *Utah, *Fish management, *Woundfin, *Water management, *Virgin River, Quail Creek, Arizona, Nevada, Water resources development, Flow profiles, Ecological effects, Red shiner, Fish, Fish populations, Diversion structures.

Attempts to define conditions permitting compatible existence of endangered fishes and water development projects in the Virgin River basin of Utah, Arizona, and Nevada have met with limited success. The Quail Creek water project was completed in 1985 following acceptance of conditions judged essential to ensure survival of woundfin. Flow requirements specified for that project, however, may have been violated almost constantly in June-October 1985 and June-September 1986. In late May 1985 the entire Virgin River immediately below the Quail Creek diversion structure disappeared into sink holes that developed in the river bed. At about that time discharge into the river bed from the hot saline Pah Tempe springs located about 4.4 km downstream increased from 0.3 to an estimated 0.85-1.2 cu m/sec. Native fish populations declined throughout the Utah segment of the Virgin River in 1985 and reproduction was poor to nonexistent above Quail Creek. Some species recovered and reproduced well following improvements in water quality in 1986. During 1985-86 the exotic red shiner became the dominant species throughout the Arizona/Nevada reach of the Virgin River while native species declined. Management of endangered species in the Virgin River requires a continuous flow of information on population status, habitat requirements, and biotic interactions that must be integrated into the numerous water management activities in the system. (Author's abstract)
W89-00311

MICROBIAL BIOMASS, ACTIVITY, AND COMMUNITY STRUCTURE OF WATER AND PARTICULATES RETRIEVED BY BACKFLOW FROM A WATERFLOOD INJECTION WELL,
Calgary Univ. (Alberta). Dept. of Biology.
For primary bibliographic entry see Field 5B.
W89-00334

STUDY OF MODERN VICISSITUDES OF THE JIANGHAN LAKE GROUP BY USING REMOTE SENSING TECHNIQUES,
Central China Teacher's Univ., Wuchang (China).
For primary bibliographic entry see Field 2H.
W89-00542

EFFECTS ON THE BENTHIC FAUNA OF EMBANKING AN INTERTIDAL FLAT AREA (THE MARKIEZAAT, EASTERN SCHELDT ESTUARY, THE NETHERLANDS),
Nederlands Inst. voor Onderzoek der Zee, Texel.
H. Hummel, E. B. M. Brummelhuis, and L. DeWolf.
Netherlands Journal of Sea Research NJSRBA, Vol. 20, No. 4, p 397-406, December 1986. 8 fig, 1 tab, 29 ref.

Descriptors: *Benthos, *Tidal flats, *Submerged plants, *Scheldt estuary, *Estuaries, *Embankments, *Intertidal areas, Tides, The Netherlands, Submergence, Mortality, Seasonal variation, Saline water, Stagnant water.

Effects of embanking an intertidal-flat area on abundance and condition of benthic animals were followed at three stations during spring 1983 in the south-western part of the Netherlands. Part of the former intertidal flats became permanently submerged with stagnant salt water whereas another part became permanently emerged. At the submerged sampling station, no clear changes were found during the first 3 months of submersion. However, within 6 months, most species died off. At the drained stations, all individuals of most species died off within 2 months. During some preliminary experiments with drained sediment cores, a high mortality of the animals was reached within much shorter periods. During these experiments, the animals showed a retarded mortality after they had been returned to a normal tidal cycle. Species living in the lower part of the intertidal zone were less tolerant to drainage than those living in the higher part. The observed mortality rates in the Markiezaat probably represent minimal values, because of the heavy rainfall and the absence of extreme temperatures during drainage. At high (summer) and low (winter) temperatures and low precipitation, benthic animals may be less tolerant to drainage. Neither permanent submersion nor emersion affected the condition determined as dry weight per unit of volume. Therefore, the suitability of this condition-index as an indicator of stress for intertidal benthic animals may be questioned. (Author's abstract)
W89-00676

MICROSCALE HALINE CONVECTION - A PROPOSED MECHANISM FOR TRANSPORT AND MIXING AT THE WATER TABLE REGION,
Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.
For primary bibliographic entry see Field 2F.
W89-00718

EVALUATING PEAT-MINING HYDROLOGY USING DRAINMOD,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 4C.
W89-00755

REGULATION OF THE RIVER THAMES: A CASE STUDY ON THE TEDDINGTON FLOW PROPOSAL,
Thames Water Authority, Reading (England).
For primary bibliographic entry see Field 4A.
W89-00955

HYDROLOGICAL CHANGES AND THE RIVER REGULATION IN THE UK,
University Coll. of Wales, Aberystwyth. Dept. of Geography.
For primary bibliographic entry see Field 4A.
W89-00957

CHANNEL CHANGE AND SEDIMENT TRANSPORT IN REGULATED U.K. RIVERS,
Freshwater Biological Association, Ambleside (England).
For primary bibliographic entry see Field 2J.
W89-00958

IMPACT OF RIVER REGULATIONS ON INVERTEBRATE COMMUNITIES IN THE U.K.,
Nature Conservancy Council, Peterborough (England).
For primary bibliographic entry see Field 4A.
W89-00959

RIVER REGULATION AND NATURE CONSERVATION,
Nature Conservancy Council, Peterborough (England).
For primary bibliographic entry see Field 4A.
W89-00961

STREAMFLOW REGULATION AND FISH COMMUNITY STRUCTURE,
Massachusetts Univ., Amherst. Dept. of Forestry and Wildlife Management.
For primary bibliographic entry see Field 4A.
W89-01053

CHANGES IN THE ECOSYSTEM OF THE AZOV SEA IN RELATION TO ECONOMIC DEVELOPMENT IN THE BASIN,
Azovskii Nauchno-Issledovatel'skii Inst. Rybnogo Khozyaistva, Rostov-na-Donu (USSR).
S. P. Volovik.
Journal of Ichthyology JITHA2, Vol. 26, No. 2, p 1-15, 1986. 3 fig, 3 tab, 72 ref. Originally published in Voprosy Ikhtiologii, No. 1, 1986, pp 33-47.

Descriptors: *Azov Sea, *Economic development, *Ecosystems, *Productivity, *Geologic history, Closed lakes, Fisheries, Aquatic habitats, Seasonal distribution.

A generalized characterization of the major changes in the ecosystem of the Azov Sea over the past thirty years is presented and its productivity is assessed for different salinity levels. Reserves of bioproduction potential are identified. Anthropogenic changes in the environmental regime are associated with seasonal distribution of discharge of river waters and reduction of floods increased water consumption, qualitative and quantitative changes in nutrients, and by advection of Black Sea waters. The Azov Sea formed in an area with a complex geological past, which determined the peculiarities of its flora and fauna. The organisms found here are of different origins and belong to freshwater, brackish water, Caspian relict and Atlantic-Mediterranean complexes. The transformations of the marine regime destroyed the original structure of the ecosystem and reduced productivity of the planktonic and benthic communities. The intensity and magnitude of transformation of the ecosystem increases with an increase in the anthropogenic action. However, even under significant transformations of regime and biota the Azor Sea continues to be highly productive. Even under conditions of intensive exploitation and economic development, the conditions of the Azov Sea can be improved and its fisheries restored. (Miller-PTT)
W89-01192

FECUNDITY DYNAMICS OF KHRAMULYA, VARICORHINUS CAPOETA SEVANGI, IN RELATION TO THE CHANGING ENVIRONMENT OF LAKE SEVAN,
Akademiya Nauk Armyanskoi SSR, Sevan. Hydrobiological Station.
For primary bibliographic entry see Field 2H.
W89-01194

7. RESOURCES DATA

7A. Network Design

STATISTICAL METHODS AND SAMPLING DESIGN FOR ESTIMATING STEP TRENDS IN SURFACE-WATER QUALITY,
Geological Survey, Reston, VA.
R. M. Hirsch.
Water Resources Bulletin WARBAQ, Vol. 24, No. 3, p 493-503, June 1988. 9 fig, 1 tab, 15 ref.

Descriptors: *Network design, *Data interpretation, *Trend analysis, *Statistical methods, *Water quality, *Estimating, *Water sampling, Simulation analysis, Nonparametric testing, Simulation, Potomac River, Phosphorus, Path of pollutants, Surface water.

This paper addresses two components of the problem of estimating the magnitude of step trends in surface water quality. The first is finding a robust estimator appropriate to the data characteristics expected in water-quality time series. The Hodges-Lehmann class of estimators is found to be robust in comparison to other nonparametric and moment-based estimators. A seasonal Hodges-Lehmann estimator is developed and shown to have desirable properties. Second, the effectiveness of various sampling strategies are examined using Monte Carlo simulation coupled with application of this estimator. The simulation is based on a large set of total phosphorus data from the Potomac River. To assure that the simulated records have realistic properties, the data are modeled in a multiplicative fashion incorporating flow, hysteresis, seasonal, and noise components. The results demonstrate the importance of balancing the length of

the two sampling periods and balancing the number of data values between the two periods. The inefficiency of sampling at frequencies much in excess of 12 samples per year is demonstrated. Rotational sampling designs are discussed, and efficient designs, at least for this river and constituent, are shown to involve more than one year of active sampling at frequencies of about 12 per year. (See also W89-00861) (Author's abstract)
W89-00862

MODERN MANAGEMENT STANDARDS OF WATER NETWORK REGISTER (CRITERES MODERNES DE GESTION DU CADASTRE DES RESEAUX D'EAU),
Azienda Comunale Elettricita ed Acque, Rome (Italy).
For primary bibliographic entry see Field 5F.
W89-00919

METHOD FOR LOCATING WELLS IN A GROUNDWATER MONITORING NETWORK UNDER CONDITIONS OF UNCERTAINTY,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
P. D. Meyer, and E. D. Brill.
Water Resources Research WRERAO, Vol. 24, No. 8, p 1277-1282, August 1988. 5 fig, 2 tab, 13 ref.

Descriptors: *Network design, *Observation wells, *Uncertainty, *Monitoring, *Groundwater pollution, Wells, Model studies, Simulation, Well data, Path of pollutants, Plumes, Networks, Data collections.

A method is presented for locating wells in a monitoring network under conditions of uncertainty. This method couples the use of a simulation model of contaminant transport and a facility location model. The Monte Carlo technique is used with the simulation model to translate uncertainty in the simulation model parameters into uncertainty in the contaminant concentration distribution. The simulation model determines which well locations would detect a given realization of a contaminant plume with a concentration above a specified limit. The facility location model is then used to select a fixed number of well locations so that a maximum number of such plume realizations are detected. The selected well network maximizes the probability of detection. The method is applied to an example problem. Although the technique is computationally intensive, the results indicate that practical problems are tractable. (Author's abstract)
W89-00971

7B. Data Acquisition

HYPOLIMNETIC CHLOROPHYLL MAXIMUM BY ALGAE AND SULPHUR BACTERIA IN ONE EUTROPHIC POND,
Jyvaeskylae Univ. (Finland). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W89-00012

SIMPLE SELF-ACTING HYDROBIOLOGICAL SAMPLER (PROSTY SAMOCZYNNY CZERPACZ HYDROBIOLOGICZNY),
Wyzsza Szkola Pedagogiczna, Olsztyn-Kortow (Poland).
A. Swiatecki, and W. Gorski.
Wiadomosci Ekologiczne WEKLAP, Vol. 33, No. 3, p 291-295, 1987. 2 fig, 5 ref.

Descriptors: *Samplers, *Sampling, *Phytoplankton, *Hydrobiology, Limnology, Water sampling.

Technical data, schematic diagram and a diagram showing the operation of a water sampler for hydrobiological investigations are given. The sampler is made of readily available materials and is simple to assemble and operate. The sampler has two autonomous reservoirs: one to obtain 450 ml of water for basic hydrochemical and phytoplanktonic investigations and another 10-50 ml of water for microbiological investigations. It can be used for sampling water from a chosen depth or from several depths at the same time by means of a set of samplers in series. (Author's abstract)
W89-00033

DETERMINATIONS OF SUSPENDED SEDIMENT CONCENTRATIONS FROM MULTIPLE DAY LANDSAT AND AVHRR DATA,
Ohio State Univ., Columbus. Dept. of Civil Engineering.
J. G. Lyon, K. W. Bedford, C. J. Yen, D. H. Lee, and D. J. Mark.
Remote Sensing of Environment RSEEA7, Vol. 25, No. 1, p 107-115, July 1988. 4 fig, 1 tab, 19 ref.
NOAA, Office of Sea Grant Contracts NA81AA-D-00095 and NA84AA-D-00079 (R/EM-2, R/EM-7, and R/EM-8).

Descriptors: *Suspended sediments, *Satellite technology, *Remote sensing, *Sediment distribution, Mathematical models, On-site data collections, Lake Erie.

A combination of Satellite data, on-site sampling, and hydrodynamic and water quality model simulations was used to evaluate surface sediment concentrations in Sandusky Bay, Lake Erie. Both satellite brightness values and categorizations of total suspended sediment concentrations from Landsat and AVHRR (Advanced Very High Resolution Radiometer) data were evaluated from the period of June 10-28, 1981. The satellite data products displayed many of the trends in concentrations recorded by the on-site data, and were similar to the results of hydrodynamic and water quality (HWQ) model simulations reported elsewhere. (Author's abstract)
W89-00064

LANDSAT-MSS RADIANCE AS A MEASURE OF SUSPENDED SEDIMENT IN THE LOWER YELLOW RIVER (HWANG HO),
Exeter Univ. (England). Dept. of Geography.
S. Aranuvachapun, and D. E. Walling.
Remote Sensing of Environment RSEEA7, Vol. 25, No. 2, p 145-165, July 1988. 12 fig, 1 tab, 27 ref.
The U.K. Natural Environmental Research Council Research Grant GR3/5914.

Descriptors: *Light intensity, *Suspended sediments, *Satellite technology, *Remote sensing, *Sediment distribution, Radiation, Data interpretation, Yellow River, China.

A method of converting the Landsat-MSS radiance to an estimate of suspended sediment concentration is presented. The CCT (computer comparable tape) data for the Lower Yellow River (Hwang Ho) were first corrected for instrumental error due to a drift in the sensor response and then converted to the absolute radiance received by the sensor. In order to understand the detected radiance and its variability, radiative transfer in the earth's atmosphere and natural waters are discussed. The radiative transfer equation has been simplified, so that a highly accurate atmospheric correction algorithm for diffuse sky radiance may be developed. However, the MSS is more sensitive to the direct sky radiance, and so an atmospheric correction based on the normalization of the solar angle is considered. Following a logarithmic relationship between radiance and suspended sediment concentration, the corrected remote-sensing radiance is used to estimate suspended sediment concentrations in the Lower Yellow River. The results suggest that the relationship could represent a universal algorithm for estimating suspended sediment concentration, although further detailed study will be needed to investigate this property. There is also sufficient evidence to indicate that remote sensing radiance may be used to infer the sediment size distribution, which represents a very important parameter in sediment transport studies. Finally, cross sections of suspended sediment concentrations at Lijin in the Lower Yellow River are derived from the satellite data, and a map of sediment distribution in the estuary is also presented. (Author's abstract)
W89-00065

PARTICULATE CONCENTRATIONS IN LAKE ST. CLAIR AS RECORDED BY A SHIPBORNE MULTISPECTRAL OPTICAL MONITORING SYSTEM,
National Water Research Inst., Burlington (Ontario). Rivers Research Branch.
R. P. Bukata, J. H. Jerome, and J. E. Bruton.
Remote Sensing of Environment RSEEA7, Vol. 25, No. 2, p 201-229, July 1988. 19 fig, 14 ref.

Descriptors: *Light intensity, *Reflectance, *Suspended sediments, *Seston, *Remote sensing, *Sediment distribution, Radiation, Multispectral monitoring, Lake St. Clair, Data interpretation.

Methodology is developed to convert the upwelling multispectral radiance observed by a ship-mounted dual radiometer reflectance system into the subsurface volume reflectance normalized to a standard solar zenith angle and a standard downwelling light field. This normalized multispectral subsurface volume reflectance is then utilized to evaluate the capacity of effectively conducting, from a moving research vessel, a continuous monitor of the total seston and suspended sediment concentrations in the generally turbid, shallow waters of Lake St. Clair. Good agreement is obtained between remotely predicted and directly sampled concentrations of both seston and suspended sediments. (Author's abstract)
W89-00066

CORRELATIONS BETWEEN SALINITY AND GROWTH OF THE SEAGRASS AMPHIBOLIS ANTARCTICA (LABILL.) SONDER & ASCHERS., IN SHARK BAY, WESTERN AUSTRALIA, USING A NEW METHOD FOR MEASURING PRODUCTION RATE,
Western Australia Univ., Nedlands. Dept. of Botany.
For primary bibliographic entry see Field 2L.
W89-00102

OXYGEN BUDGET OF A RIVER IN SUBMERGED MACROPHYTES (RIVER ZSCHOPAU IN THE SOUTH OF THE GDR),
Technische Univ., Dresden (German D.R.). Sektion Wasserwesen.
For primary bibliographic entry see Field 2H.
W89-00137

DETERMINATION OF ORGANIC MATTER IN RIVER SEDIMENTS,
Oesterreichische Akademie der Wissenschaften, Vienna. Biologische Station.
G. Bretschko, and M. Leichtfried.
Archiv fuer Hydrobiologie, Supplement AHBSA8, Vol. 68, No. 3/4, p 403-417, May 1987. 6 fig, 4 tab, 76 ref.

Descriptors: *Water analysis, *Chemical analysis, *Rivers, *Sediments, *Organic matter, *Organic carbon, Nitrogen, Phosphorus, Wet oxidation method, Ignition method.

The importance of organic matter in ecosystems is characterized and the traditional methods for determining organic matter (wet oxidation and loss of weight on ignition) are discussed. It is shown that both methods are inadequate for general use. Organic carbon is proposed for quantifying organic matter. The precision of organic carbon determinations with the is described. The characterization of the nutritive quality of organic matter by means of nitrogen and phosphorous concentrations is discussed. A method for determining phosphorous and nitrogen in one sample as well as an approximation to differentiate between organic and inorganic bound nitrogen and phosphorous are described. (Author's abstract)
W89-00169

QUANTUM YIELD AS A FUNDAMENTAL PARAMETER CONTROLLING VERTICAL PHOTOSYNTHETIC PROFILES OF PHYTOPLANKTON IN LAKE CONSTANCE,
Konstanz Univ. (Germany, F.R.). Limnological Inst.

For primary bibliographic entry see Field 2H.
W89-00176

CATALYTIC DETERMINATION OF COPPER IN NATURAL WATER AT MICROGRAM/L LEVEL BY FLOW INJECTION ANALYSIS, (IN CHINESE),
Yellow Sea Fisheries Research Inst., Qingdao (China).
Y. Youxian, and Q. Keming.
Oceanologia et Limnologia Sinica, Vol. 19, No. 2, p 157-163, March 1988. 7 fig, 1 tab, 12 ref. English summary.

Descriptors: *Chemical analysis, *Trace metals, *Water analysis, *Copper, Flow injection analysis, Spectrophotometry, Natural waters, Pollutant identification.

A flow injection analytical method based on the catalytic action of Cu(II) on the oxidation of hydroquinone by hydrogen peroxide was devised. A 0.90% H2O2 aqueous solution containing phosphate buffer (pH 7-7.2) and 3.5% hydroquinone solution were used as carrier streams at flow rates of 2.18 and 1.75 ml/min, respectively. The reaction coil was teflon tubing (0.8 mm i.d.) 450 cm in length. A Shimadzu UC-365 recording spectrophotometer equipped with an 8 microliter flow cell was used as detector. The quinone formed was monitored at 420 nm. Twenty-four samples could be injected per hour with a 250 microliter sample. The calibration curve is linear in the range 0-50 microgram/L Cu with a detection limit of 0.7 microgram/L. The coefficient of variation was 2.93% for a 40 microgram/L Cu standard solution. This method was applied to the determination of trace amounts of Cu in natural waters with a 90-104% recovery. (Author's abstract)
W89-00201

INSTRUMENTATION FOR 7-DAY CONTINUOUS CYCLE MONITORING OF METALS WITH AUTOMATED ON-LINE SAMPLE PREPARATION, HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY, AND ELECTROCHEMICAL DETECTION,
Deakin Univ., Melbourne (Australia). Div. of Chemical and Physical Sciences.
For primary bibliographic entry see Field 5A.
W89-00210

NITRATE REDUCTASE ACTIVITY IN PHYTOPLANKTON FROM THE OSLO-FJORD, NORWAY,
Oslo Univ. (Norway). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W89-00226

HABITAT REQUIREMENTS AND BIOINDICATOR VALUE OF THE MAIN COMMUNITIES OF AQUATIC VEGETATION IN NORTH-EAST POLAND,
Warsaw Univ. (Poland). Dept .of Phytogeography.
For primary bibliographic entry see Field 2H.
W89-00235

DETERMINATION OF HYDROPHILIC THIOLS IN SEDIMENT POREWATER USING ION-PAIR LIQUID CHROMATOGRAPHY COUPLED TO ELECTROCHEMICAL DETECTION,
National Bureau of Standards (NML), Gaithersburg, MD. Center for Analytical Chemistry.
D. Shea, and W. A. MacCrehan.
Analytical Chemical ANCHAM, Vol. 60, No. 4, p 1449-1454, July 1988. 7 fig, 3 tab, 24 ref.

Descriptors: *Geochemistry, *Biochemistry, *Water analysis, *Thiols, *Sulfur compounds, *Analytical methods, *Liquid chromatography, Detection limits, Performance evaluation, Chromatography, Estuarine sediments, Measuring instruments, Sediments, Chesapeake Bay.

Twelve hydrophilic thiols in sediment porewater samples from the Chesapeake Bay were determined by reverse-phase high-performance liquid chromatography using trihaloacetate ion-pairing agents with amperometric detection at a mercury-film/gold electrode. The detection limit is about 2 pmol, and the precision is better than 3% at the 100-pmol level. Glassy carbon and bare gold electrodes were also examined but had higher residual currents and were subject to more interferences than the mercury-film/gold electrode. The stability of thiols with respect to oxidation, in both standard solutions and samples, was also investigated under various conditions. (Author's abstract)
W89-00266

ISOTOPE RATIO MEASUREMENTS OF MO, V, TI, AND ZR AND THE DETERMINATION OF THESE ELEMENTS IN WATER SAMPLES WITH A THERMAL IONIZATION QUADRUPOLE MASS SPECTROMETER (ISOTOPENVERHALTNISMESSUNG VON MO, V, TI AND ZR SOWIE DEREN KONZENTRATIONSBESTIMMUNG IN WASSERN MIT EINEM THERMIONEN-QUADRUPOL-MASSENSPEKTROMETER),
Regensburg Univ. (Germany, F.R.). Inst. fuer Anorganische Chemie.
For primary bibliographic entry see Field 5A.
W89-00267

CHROMIUM TRACE DETERMINATION IN INORGANIC, ORGANIC AND AQUEOUS SAMPLES WITH ISOTOPE DILUTION MASS SPECTROMETRY (CHROMSPURENBESTIMMUNGEN IN ANORGANISCHEN, ORGANISCHEN UND WABRIGEN PROBEN MIT DER MASSENSPEKTROMETRISCHEN ISOTOPENVERDUNNUNGSANALYSE),
Regensburg Univ. (Germany, F.R.). Inst. fuer Anorganische Chemie.
For primary bibliographic entry see Field 5A.
W89-00268

DETERMINATION OF NITRATE AT THE NG/G LEVEL IN ANTARCTIC SNOW SAMPLES WITH ION CHROMATOGRAPHY AND ISOTOPE DILUTION MASS SPECTROMETRY,
Regensburg Univ. (Germany, F.R.). Inst. fuer Anorganische Chemie.
For primary bibliographic entry see Field 5A.
W89-00269

WOUND FIBERGLASS DEPTH FILTERS AS A LESS EXPENSIVE APPROACH FOR THE CONCENTRATION OF VIRUSES FROM WATER,
Institut Armand-Frappier, Laval (Quebec). Centre de Recherche en Virologie.
For primary bibliographic entry see Field 5A.
W89-00279

NOVEL APPROACH FOR MODIFYING MICROPOROUS FILTERS FOR VIRUS CONCENTRATION FROM WATER,
Florida Univ., Gainesville. Dept. of Microbiology and Cell Science.
For primary bibliographic entry see Field 5A.
W89-00332

NATIONAL FIELD EVALUATION OF A DEFINED SUBSTRATE METHOD FOR THE SIMULTANEOUS ENUMERATION OF TOTAL COLIFORMS AND ESCHERICHIA COLI FROM DRINKING WATER: COMPARISON WITH THE STANDARD MULTIPLE TUBE FERMENTATION METHOD,
Yale Univ., New Haven, CT. School of Medicine.
For primary bibliographic entry see Field 5A.
W89-00337

ESTIMATION OF BARE SOIL EVAPORATION FROM AIRBORNE MEASUREMENTS,
Centre de Recherches en Physique de l'Environnement, Issy-les-Moulineaux (France).
J. V. Soares, R. Bernard, O. Taconet, D. Vidal-Madjar, and A. Weill.
Journal of Hydrology JHYDA7, Vol. 99, No. 3/4, p 281-296, May 30, 1988. 10 fig, 2 tab, 23 ref, append.

Descriptors: *Remote sensing, *Infrared imagery, *Microwaves, *Soil water, *Evaporation rate, *Thermal radiation, *Evapotranspiration, Soil temperature, Energy, Spatial variation, Temporal variation, France, SODAR.

C-band (5 GHz) active microwave instruments can be used to sense remotely the variations in space and time of soil moisture up to 5 or 10 cm below the surface. The thermal infrared radiance is also related to soil evaporation through the energy balance at the soil-air interface. If those two measurements are made simultaneously over a long period, it may be possible to monitor the actual evaporation and the soil water budget. Over a period of 10 days at the end of September 1983, airborne remote sensing equipment gave the surface temperature (from an infrared radiometer) and the surface water content (from a radar) of an essentially bare agricultural region southwest of Paris, France. Using a Deardorff-like two-reservoir parameterization the evaporation and soil water budgets were derived from the remotely sensed data. To validate the results, the sensible heat fluxes derived are compared with regional fluxes measured using a vertical Doppler SODAR. (Author's abstract)
W89-00352

VALIDITY OF THE ENVIRONMENTAL CHLORIDE METHOD FOR RECHARGE EVALUATION OF COASTAL AQUIFERS, INDIA.
National Geophysical Research Inst., Hyderabad (India).
B. S. Sukhija, D. V. Reddy, P. Nagabhushanam, and R. Chand.
Journal of Hydrology JHYDA7, Vol. 99, No. 3/4, p 349-366, May 30, 1988. 5 fig, 5 tab, 25 ref.

Descriptors: *Environmental chloride method, *Aquifer characteristics, *Groundwater recharge, *Tritium injection, *Coastal aquifers, *Aquifer testing, Radioactive tracers, Performance evaluation, Pondicherry, Chlorides, Semiarid climates, Comparison studies, Tropical regions, India.

The validity of the environmental chloride method was tested for evaluation of groundwater recharge to coastal aquifers situated in a semi-arid tropical area under the influence of a monsoonic type of hydrologic regime. A comparative study, using environmental chloride in conjunction with the injected tritium method, was undertaken in the coastal aquifers of Pondicherry, situated about 160 km south of Madras, along the coast of the Bay of Bengal. Five each of environmental chloride (repeated twice) and injected tritium profiles were studied in the alluvium and Cuddalore aquifers of Pondicherry. Recharge from the chloride study was estimated using the concentration approach, which involved estimating the relative enrichment of soil chloride concentration in relation to the input chloride, and the flux approach, determining the turnover time of soil moisture by estimating the total chloride in the profile and yearly input. Recharge from the injected tritium profiles was estimated by studying the displacement of soil moisture during the time interval between sampling and injection of the tracer. Reported chloride profiles show fairly good reproducibility (within 15-30%) of recharge rates determined by the two approaches for two different sampling times at the same site. Also, the results compare well among the two approaches used for the chloride method. Mean recharge rates obtained by the injected tritium method for the Cuddalores is about 26 cm/yr and by the chloride method about 22 cm/yr; for the alluvium the respective rates are 10 and 14 cm/yr. This shows fairly good agreement between the two methods. The study thus demonstrates the conformity of recharge rates determined by the environmental chloride method for recharge measurements for tropical coastal aquifers situated in semi-arid regions. (Author's abstract)
W89-00356

DETERMINATION OF MONO- AND DIVALENT CATIONS AND ANIONS IN SMALL FOG SAMPLES BY ION CHROMATOGRAPHY,
Paul Scherer Inst., Wuerenlingen (Switzerland).
For primary bibliographic entry see Field 5A.
W89-00372

CREEP OF ICE MEASURED WITH THE PRESSUREMETER,
Atomic Energy of Canada Ltd., Pinawa (Manitoba).
For primary bibliographic entry see Field 2C.
W89-00387

SELECTED DYES FOR RESIDENCE TIME DISTRIBUTION EVALUATION IN BIOREACTORS,
Universidad Nacional Autonoma de Mexico, Mexico City. Inst. de Ingenieria.
For primary bibliographic entry see Field 5D.
W89-00404

EFFECT OF ASSUMED UNIT GRADIENT DURING DRAINAGE ON THE DETERMINATION OF UNSATURATED HYDRAULIC CONDUCTIVITY AND INFILTRATION PARAMETERS,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
For primary bibliographic entry see Field 2G.
W89-00407

EVALUATING THE MODIFICATIONS TO THE MF TOTAL COLIFORM METHOD FOR DRINKING WATER WITH HIGH NONCOLIFORM BACKGROUNDS,
Wisconsin State Lab. of Hygiene, Madison.
For primary bibliographic entry see Field 5A.
W89-00427

REMOTE SENSING APPLICATIONS IN WATER RESOURCE PROSPECTING AND MANAGEMENT,
International Bank for Reconstruction and Development, Washington, DC. Water and Telecommunications Div.
S. V. R. Rao.
Resource Management and Optimization RMOPDH, Vol. 6, No. 1, p 35-44, December 1987. 15 ref.

Descriptors: *Planning, *Policy making, *Remote sensing, *Water resources management, *Groundwater management, Aquifers, Seepage, Groundwater quality, Path of pollutants, Hazardous wastes, Data acquisition, Water quality.

Remote sensing can be extremely useful for prospecting of the groundwater resources, so that appropriate management decisions can be made for proper utilization of groundwater resources. Satellite imageries can provide valuable information with regard to the location of the aquifers, and seepage rates of water from the streams and rivers. Groundwater contamination can also be adequately monitored with satellite imagery. Remote sensing techniques utilizing satellite imageries can be extremely useful for tracking the course of hazardous spills in the streams and rivers, which would otherwise not be possible ground based measurements. Similarly, remote sensing techniques utilizing satellite imageries can provide continuous monitoring of surface water quality in rivers, streams and lakes. This has the great advantage over the ground based continuous monitoring with automated instrumentation in being quite inexpensive and in not being open to interruptions of data acquisition. (Author's abstract)
W89-00459

DETERMINATION OF COBALT IONS IN NATURAL WATERS USING DIFFERENTIAL PULSE ADSORPTIVE STRiPPING VOLTAMMETRY,
Academia Sinica, Qingdao (China). Inst. of Oceanology.
For primary bibliographic entry see Field 5A.
W89-00480

DETERMINATION OF TRACES OF BISMUTH IN WATER WITH POLYURETHANE FOAM THIN-LAYER SPECTROPHOTOMETRY,
National Research Centre, Cairo (Egypt). Microanalytical Research Lab.
For primary bibliographic entry see Field 5A.
W89-00482

BENTHIC CHAMBER FOR USE IN RIVERS: TESTING AGAINST OXYGEN MASS BALANCES,
Ministry of Works and Development, Hamilton (New Zealand). Water Quality Centre.
C. W. Hickey.
Journal of Environmental Engineering (ASCE) JOEDDU, Vol. 114, No. 4, p 828-845, August 1988. 3 fig, 2 tab, 53 ref.

Descriptors: *Respiration, *Photosynthesis, *Measuring instruments, *Benthic environment, *Oxygen balance, Rivers, In situ tests, Oxygen uptake, Aquatic fungi, Mass transfer, Flow velocity.

An in-situ benthic chamber has been developed in order to measure rates of respiration and photosynthesis in rivers. Oxygen mass balances for three rivers show satisfactory agreement between chamber (24.7-52.3 g/sq m/day) and calculated net (28.3-77.2 g/sq m/day) benthic oxygen uptake rates (BUR) by matching chamber (0.25-0.35 m/s) and river (0.25-0.40 m/s) boundary velocities (each measured 0.05 m above bed). The BUR is a function of the flow velocity of the overlying water, with both sewage fungus biofilms and pumice sediments each showing a large positive response and approximately linear relationship to velocity over the range studied (0.06-0.35 m/s). Measurements of the oxygen mass transfer coefficient for the air-water interface of an inverted chamber showed that the response to flow velocity was not significantly different ($P > 0.05$) from that predicted using the O'Connor-Dobbins formula. Chamber devices adequately simulate natural hydrodynamic conditions and future mathematical modeling should aim to incorporate overlying water velocity into kinetic expressions describing river BUR. (Author's abstract)
W89-00488

DETERMINATION OF TRACE CHROMIUM IN NATURAL WATER BY POLAROGRAPHIC CATALYTIC WAVE ANALYSIS, (IN CHINESE),
For primary bibliographic entry see Field 5A.
W89-00538

EXTRACTION AND DETERMINATION OF CHLOROPHYLL FROM BENTHIC GREEN ALGAE WITH DIMETHYL SULFOXIDE, (IN CHINESE),
Academia Sinica, Qingdao (China). Inst. of Oceanology.
T. Guiying, and Z. Baicheng.
Oceanologia et Limnologia Sinica OECOBX, Vol. 18, No. 3, p 295-300, May 1987. 4 fig, 3 tab, 4 ref. English summary.

Descriptors: *Chlorophyta, *Chlorophyll, *Chemical analysis, *Water analysis, Algae, Reagents, Dimethyl Sulfoxide, Benthic flora, Pigments, Comparative studies.

Using dimethyl sulfoxide and 80% acetone as the solvent, chlorophylls of three species of benthic green algae, Enteromopha linza (L.) J. Ag., Ulva pertusa Kjellm and Monostroma angicava Kjellm, were extracted and determined. The method was compared with Arnon's in which 80% acetone was used as the solvent. With equal amounts of chlorophyll, the absorption peaks in dimethyl sulfoxide/80% acetone were 6, 7 and 8% higher than those in 80% acetone at wave lengths of 663, 652 and 645 nm, respectively. Chlorophyll amounts would be over estimated if Arnon's formula was used. For exact determination, the figures must be corrected. In dimethyl sulfoxide/80% acetone and in 80% acetone, the stabilities of the chlorophylls were identical. When the chlorophylls were kept in the dark for seven days, at two different room temperatures of 14 C and 5 C, the values were basically unchanged. However, if the chlorophylls were kept separately in dim (0.2-0.3 mW/sq cm) and bright light (1.9 mW/sq cm) for only 6 hours, the total amounts of the chlorophylls were decreased by 20% and 70, respectively. In this method, it is requisite that the solution be kept in the dark. The advantage of the method is that the chlorophyll of benthic green algae can be extracted directly without grinding and centrifuging; it can be done in a much shorter time than Arnon's method. The method is highly practical for analyzing a large number of chlorophyll samples. (Author's abstract)
W89-00539

STUDY OF MODERN VICISSITUDES OF THE JIANGHAN LAKE GROUP BY USING REMOTE SENSING TECHNIQUES,
Central China Teacher's Univ., Wuchang (China).
For primary bibliographic entry see Field 2H.
W89-00542

CALCULATION OF THE SUSPENDED LOAD IN RIVERS AND CANALS,
E. I. Mikhnevich, and F. B. Saplyukov.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 1, p 25-30, July 1987. 4 fig, 2 tab, 5 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 1, p 30-34, January 1987.

Descriptors: *Sediment transport, *Water management, *Suspended load, *Turbidity, Byelorussia, Rivers, Water supply, Reservoirs, Water use, Channel improvements, Sediments.

The majority of rivers in Byelorussia are small and medium in size. The load on them is increasing: the intake of water for industry, agriculture, and domestic needs is increasing, many rivers are being straightened or embanked for purposes of land reclamation, and the construction on rivers of reservoirs and ponds is being carried out an intensified rate. These water-management measures at are substantiated by a number of indices, including the characteristics of sediment transport in rivers and canals. A combined method of calculating turbidity corresponding to the transport capacity of the flow is proposed. For the period of water discharge being considered the turbidity corresponding to it is first determined with respect to the regional annual distribution of the sediment discharge. Then on the basis of the value of the turbidity obtained the limit of a presented equation is selected and the transport capacity of the flow is calculated with respect to it. (Brock-PTT)
W89-00552

LIGNIN RESIDUES AS TRACERS OF ORGANIC WASTE TRANSPORT,
Gulf Coast Research Lab., Ocean Springs, MS.
T. F. Lytle, and J. S. Lytle.
Chemosphere CMSHAF, Vol. 16, No. 1, p 171-182, 1987. 3 fig, 1 tab, 27 ref. Dept. of Commerce, Grants NA79AA-D-0049, NA80AA-D-00017, and NA81AA-D-00050.

Descriptors: *Path of pollutants, *Pulp and paper industry, *Industrial wastes, *Lignin, Organic matter, Mississippi Sound, Sediments, Tracers, Gulf of Mexico, Phenols, East Pascagoula River, Escatawpa River, Mississippi, Rivers, Estuaries.

Lignin residues from a paper mill on the Escatawpa River, Mississippi, were used as chemical tracers for organic pollutant transport into Mississippi Sound. Sediments were sampled in this river and in the East Pascagoula River, as well as in transects across the Sound and in the Gulf of Mexico. Sediments unaffected by pulp wood waste had approximately equal abundances of vanillyl and syringyl phenols. Wood wastes contained vanillyl but no syringyl lignins. Therefore, the vanillyl/syringyl ratio (varying from 0.418 to 4.21) was used as an indicator of the degree of pollution. However, sites containing significant natural organic material tended to mask the effects of the

wood pulp waste. Most deposition of paper mill waste was found very near the source. No evidence of transport beyond the river mouth into the Sound or Gulf of Mexico was observed. (Cassar-PTT)
W89-00561

METHOD TO ASSESS PERIODIC RESPONSES OF AQUATIC MICROECOSYSTEMS TO PHOTOSYNTHETIC INHIBITION,
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
W. D. Nicholas, and A. R. Abernathy.
Chemosphere CMSHAF, Vol. 16, No. 1, p 287-295, 1987. 2 fig, 1 tab, 26 ref.

Descriptors: *Water pollution effects, *Photosynthesis, *Toxicity, Aquatic habitats, Habitats, Herbicides, Diuron, Inhibition, Algae, Lakes, Ponds, Aquatic environment, Ecosystems.

Periodic changes in pH were monitored at 30-sec intervals in naturally-derived, aquatic microecosystems. The pH of the system was controlled between two setpoints with a microcomputer. When the upper setpoint was reached, a light bank was turned off until the pH dropped to the lower setpoint, and the light was again turned on. The cycling of pH in the microcosms was analyzed using time series analysis techniques. Each experiment resulted in a 24-hour control data set and a 24-hour experimental data set that began with the addition of the photosynthetic inhibitor 3-(3,4-dichlorophenyl)1,1-diumethylurea (DCMU) at 10 ppb. The results were summarized in variance periodograms as well as least squares estimates of periodicities. No significant difference was found between controls, while DCMU caused marked effects. The technique is shown to be rapid, inexpensive, and sensitive to photosynthetic inhibition at low concentrations. (Author's abstract)
W89-00562

EFFECTS OF AQUATIC HUMIC SUBSTANCES ON ANALYSIS FOR HYDROGEN PEROXIDE USING PEROXIDASE-CATALYZED OXIDATIONS OF TRIARYLMETHANES OR P-HYDROXYPHENYLACETIC ACID,
Environmental Research Lab., Athens, GA.
R. G. Zepp, Y. I. Skurlatov, and L. F. Ritmiller.
Environmental Technology Letters ETLEDB, Vol. 9, No. 4, p 287-298, April 1988. 6 fig, 2 tab, 30 ref.

Descriptors: *Acid rain, *Water analysis, *Humic acids, *Chemical analysis, *Hydrogen peroxide, Enzymes, Oxidation, Dyes, Trace levels, Sample preparation, Natural waters, Crystal violet, Malachite green, Decomposing organic matter.

A sensitive procedure is described for trace analysis of hydrogen peroxide in water. The procedure involves the peroxidase-catalyzed oxidation of the leuco forms of two dyes, crystal violet and malachite green. The sensitivity of this procedure, as well as of another procedure based on the peroxidase-catalyzed oxidation of p-hydroxyphenylacetic acid (POHPA), is decreased in natural water samples and in aqueous solutions of aquatic humic substances. This decrease, which is less pronounced with the POHPA method, may be caused by competitive reactions of peroxidase intermediates with phenolic components of the humic substances. (Author's abstract)
W89-00634

COMPARISON OF METHODS FOR THE DETERMINATION OF CHLOROPHYLL IN ESTUARINE SEDIMENTS,
Delta Inst. for Hydrobiological Research, Yerseke (Netherlands).
For primary bibliographic entry see Field 2L.
W89-00668

DETERMINATION OF FLUORIDE ION IN WELL WATERS OF EASTWOOD SCHOOL DISTRICT, WOOD COUNTY, OHIO,
Eastwood Local Schools, Pemberville, OH.
For primary bibliographic entry see Field 5A.
W89-00684

MULTIPLE REFLECTION AND ATTENUATION OF TIME DOMAIN REFLECTOMETRY PULSES: THEORETICAL CONSIDERATIONS OF APPLICATIONS TO SOIL AND WATER,
Department of Agriculture, Ottawa (Ontario). Land Resource Research Inst.
M. Yanuka, G. C. Topp, S. Zegelin, and W. D. Zebchuk.
Water Resources Research WRERAO, Vol. 24, No. 7, p 939-944, July 1988. 5 fig, 11 ref.

Descriptors: *Geophysics, *Dielectric properties, *Soil water, *Mathematical models, *Conductivity, *Time domain reflectometry, Temporal distribution, Algorithms, Measuring instruments.

The application of time domain reflectometry (TDR) to determine soil water content, using only the time axis of a TDR trace, has been widely investigated. Other interpretations from the TDR trace, such as the determination of electrical conductivity, make use of the amplitude or reflection in the media. A multiple-reflection algorithm is developed which takes account of primary reflection first, then provides for inclusion of higher-order reflections as well. The algorithm is formulated to generate the TDR trace from a sequence of known dielectrics. The inverse case is analyzed where the dielectric constant of the layered medium is calculated from a measured TDR trace. The model allows for both conductive and non-conductive dielectrics. Experiments showed that the model is a reasonably good qualitative representation of the layered nonconductive media with a wide range of dielectric constants. There is insufficient information in a TDR trace to solve the conductive cases except for a single layer. From KCl solutions at two concentrations the experiments showed that instantaneous reflection and transmission are inadequate assumptions for conductive systems. This indicates the need for caution when applying the model to conductive media such as soils, especially where soil water content is not uniform. (See also W89-00702) (Author's abstract)
W89-00701

DETERMINATION OF ELECTRICAL CONDUCTIVITY USING TIME DOMAIN REFLECTOMETRY: SOIL AND WATER EXPERIMENTS IN COAXIAL LINES,
Department of Agriculture, Ottawa (Ontario). Land Resource Research Inst.
For primary bibliographic entry see Field 2G.
W89-00702

SINGLE-WELL TRACING METHOD FOR ESTIMATING REGIONAL ADVECTIVE VELOCITY IN A CONFINED AQUIFER: THEORY AND PRELIMINARY LABORATORY VERIFICATION,
Purdue Univ., Lafayette, IN. Dept. of Earth and Atmospheric Sciences.
For primary bibliographic entry see Field 2F.
W89-00707

ESTIMATING BACTERIAL PRODUCTION IN MARINE WATERS FROM THE SIMULTANEOUS INCORPORATION OF THYMIDINE AND LEUCINE,
Delaware Univ., Lewes. Coll. of Marine Studies.
G. Chin-Leo, and D. L. Kirchman.
Applied and Environmental Microbiology AEMIDF, Vol. 54, No. 8, p 1934-1939, August 1988. 5 fig, 4 tab, 22 ref. NSF Grants OCE 64554165, OCE 8314607, OCE 8520278, and OCE 8614170 and NOAA Sea Grant NA 86AA-D-SG040.

Descriptors: *Marine bacteria, *Aquatic productivity, *Radioactive tracers, *Dual-label method, *Thymidine, *Leucine, Estimating, Bacterial physiology, Nucleic acids, Proteins, Incubation, Incorporation rates, Transfer RNA, Chesapeake Bay.

The simultaneous incorporation of H-3-labeled thymidine and C-14-labeled leucine was examined to obtain two independent indices of bacterial production (DNA and protein syntheses) in a single incubation. Incorporation rates of leucine estimated by the dual-label method were generally higher than those obtained by the single-label method, but the differences were small (dual/single = 1.1 plus or minus 0.2) and were probably due to the presence of labeled leucyl transfer RNA in the cold trichloroacetic acid-insoluble fraction. There were no significant differences in thymidine incorporation between dual-label and single-label incubations (dual/single = 1.03 plus or minus 0.13). Addition of the two substrates in relatively large amounts (25 nM) did not increase bacterial activity during short incubations (<5 h). With the dual-label method it was found that thymidine-incorporation and leucine-incorporation rates covaried over depth profiles of the Chesapeake Bay. Estimates of bacterial production based on thymidine and leucine differed by less than 25%. Although the need for appropriate conversion factors has not been eliminated, the dual-label approach can be used to examine the variation in bacterial production while ensuring that the observed variation in incorporation rates is due to real changes in bacterial production rather than changes in conversion factors or introduction of other artifacts. (Author's abstract)
W89-00729

PHOSPHORUS DETERMINATION IN RIVERS (PHOSPHOR IN FLIESSGEWAESSERN UND SEINE ANALYTISCHE BESTIMMUNG),
Karlsruhe Univ. (Germany, F.R.). Engler-Bunte Inst.
For primary bibliographic entry see Field 5A.
W89-00735

NEGATIVE THERMAL IONIZATION MASS SPECTROMETRY OF SELENIUM: PART 1. ISOTOPE RATIO MEASUREMENTS AND DETERMINATIONS IN AQUATIC SYSTEMS WITH THE ISOTOPE DILUTION TECHNIQUE (NEGATIVE THERMIONEN-MASSENSPEKTROMETRIE VON SELEN: TEIL 1. ISOTOPENVERHAELTNISMESSUNGEN SOWIE KONZENTRATIONSBESTIMMUNGEN IN AQUATISCHEN SYSTEMEN MIT DER ISOTOPENVERDUENNUNGSANALYSE),
Regensburg Univ. (Germany, F.R.). Inst. fuer Anorganische Chemie.
For primary bibliographic entry see Field 5A.
W89-00737

DETERMINATION OF SUBSTITUTED AROMATIC AMINES IN WATER AND SEDIMENT SAMPLES,
Institut Fresenius Chemische und Biologische Laboratorien G.m.b.H., Taunusstein-Neuhof (Germany, F.R.).
For primary bibliographic entry see Field 5A.
W89-00738

FLOW SIMULATION USING CHANNEL NETWORK MODEL,
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Water Resources and Environment Div.
T. Husain, W. A. Abderrahman, H. U. Khan, S. M. Khan, and A. U. Khan.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 114, No. 3, p 424-441, August 1988. 10 fig, 2 tab, 6 ref.

Descriptors: *Model studies, *Watershed models, *Channel flow, *Simulation, *Hydraulics, *Flow control, *Flow system, *Hydraulic gates, *Networks, Agricultural hydrology, Irrigation canals, Irrigation, Reservoirs, Rainfall-runoff relationships.

The Al-Hassa irrigation system, which consists mainly of open concrete canals with different shapes and sizes, is complex in nature due to the presence of features such as gates, bottom falls, and junctions. The distribution of water through such a network is more complicated due to time-dependent inflow from the springs and reservoirs into the

system. In order to decide gate-operating policies for irrigation scheduling purposes, the unsteady flow phenomenon used throughout the system to simulate depth and discharge at various reaches with time was studied. The applicabilities and limitations of various models for approximating the solution of Saint-Venant equations were discussed. The applicabilities and limitations of various unsteady flow packages were also reviewed considering Al-Hassa network configurations. Among all the available packages, the dynamic wave operational (DWOPER) model developed by the National Weather Service was updated, and hydraulic equations on features such as junctions with distributaries, gates of submerged and free-flow types, and bottom falls were introduced. Other features, such as interactive capability and use of subsystems, were also added. The modified version of DWOPER is known as the Channel Network Model. Parameters such as gate coefficients and Manning's n-values of the channel network model were calibrated. Depth and discharge at various reaches of a subsystem were simulated and compared with the observed values. (Author's abstract)
W89-00751

SATELLITE DATA AND GEOGRAPHICAL INFORMATION SYSTEM FOR LAND USE CLASSIFICATION,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
S. F. Shih.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 114, No. 3, p 505-519, August 1988. 4 fig, 4 tab, 17 ref.

Descriptors: *Satellite technology, *Remote sensing, *Land classification, *Hydrologic data collections, *Information systems, *Data acquisitions, *Land use, *Geography, *Computers, Data processing, Classification, Systematics, Monitoring.

Landsat Multispectral Scanner System data in conjunction with the unsupervised classification technique of Earth Resources Laboratory Application Software were used to determine land use/land cover classifications. The Landsat computer compatible tapes for February 9, 1976 were analyzed to spectrally classify unique land use/land cover conditions within the Econlockhatchee River basin, Florida. The results showed that the scatter diagrams of Band 4 (0.5-0.6 um)-Band 7 (0.8-1.1 um) and Band 4-Band 6 (0.7-0.8 um) can be utilized as well as the traditional Band 5 (0.6-0.7 um)-Band 7 scatter diagram approach for classifying land use/land cover. Both the zoom transfer scope and the geographic information system have been demonstrated to be very useful tools for land use/land cover classification of Landsat data. The Landsat data can be successfully used to monitor the USGS land use/land cover Level I, and the cost and time requirements for the Landsat approach are much less than for the conventional method. Another benefit of Landsat data is that new data are periodically available for updating the land use/land cover information. (Author's abstract)
W89-00756

MOBILE FLUME FOR CIRCULAR CHANNEL,
Ecole Polytechnique Federale de Lausanne (Switzerland). Dept. de Genie Civil.
W. H. Hager.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 114, No. 3, p 520-534, August 1988. 7 fig, 3 tab, 7 ref, append.

Descriptors: *Sewer hydraulics, *Flow measurement, *Measuring instruments, *Drainage canals, Flumes, Sewers, Discharge measurement, Channel morphology.

A simple device to measure discharge in sewers and drainage channels is described. The unit can be quickly fixed and removed for short-time use in circular channels. Its major advantages include low cost, reading precision, insensitivity to backwater submergence, and rapid installation in running water. A disadvantage is its limited use in terms of time whenever the water contains significant undissolved matter; the unit should be removed if it is not being supervised, since flooding or clogging might otherwise result. The governing equation for discharge as a function of approaching flow depth is established, and several recommendations for its practical use are given. (Author's abstract)
W89-00757

STOCHASTIC FORECAST OF WATER LOSSES,
Ohio Univ., Athens. Dept. of Civil Engineering.
T. J. Chang.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 114, No. 3, p 547-558, August 1988. 6 fig, 5 tab, 13 ref.

Descriptors: *Water loss, *Resources, Management, *Hydrologic budget, *Stochastic process, *Stochastic hydrology, *Hydrologic models, Catchment areas, Irrigation efficiency, Water distribution, Water use, Watersheds, Future planning, Ohio River, Models study, Forecasting.

For the purpose of irrigation and water resources planning, it is important to know the water loss for a drainage basin. Unfortunately individual measurements of elements of the total water loss are not realistic, at least for the large watersheds studied in this research. Based on the water budget approach, annual water loss series are formulated in this paper. A modeling technique that includes the homogeneity test of data and the best model selection is developed to fit the water loss series by a stochastic process. The results of this study reveal the existence of data inhomogeneities in the annual water loss series from the Ohio River Basin, which requires adjustments before the model fitting by a stochastic process. The selected best model by the criterion of parsimony of parameters was successfully used to forecast the regional water losses based on the proposed procedure. (Author's abstract)
W89-00759

EXPLICIT SOLUTION TO GREEN-AMPT EQUATION FOR NONUNIFORM SOILS,
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
G. N. Flerchinger, F. J. Watts, and G. L. Bloomsburg.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 114, No. 3, p 561-565, August 1988. 1 fig, 9 ref.

Descriptors: *Mathematical studies, *Mathematical equations, *Soil profiles, *Soil water, *Green-Ampt equation, *Infiltration, Capillary water, Computer models, Soil horizons, Model studies, Prediction, Soil porosity, Percolation.

In this paper, an explicit equation is developed for the accumulated infiltration over time for vertically heterogeneous soils by using a power series approximation to a logarithmic term. This equation is then used to develop a method to predict the change in infiltrated volume for a discrete time step. The potential error due to the power series approximation is never greater than 8% and is usually much less. Since computer models of infiltration and runoff processes are usually based on discrete time steps, an equation that could directly predict the potential infiltration depth during an incremental time change is developed. By using a power series approximation ot a logarithmic term, an explicit solution of the Green-Ampt equation was developed for predicting accumulated infiltration into nonuniform soils. A similar relation was also developed that predicts change in the depth of infiltration for a discrete time step. The expression obtained is relatively simple, and may be easily programmed for use in hydrologic models to predict infiltration and runoff for nonuniform soils. (Friedmann-PTT)
W89-00760

RAIN MEASUREMENT BY RAINGAGE-RADAR COMBINATION: A GEOSTATISTICAL APPROACH,
Institut de Mecanique de Grenoble, Saint-Martin d'Heres (France).
J. D. Creutin, G. Delrieu, and T. Lebel.
Journal of Atmospheric and Oceanic Technology JAOTES, Vol. 5, No. 1, p 102-115, February 1988. 6 fig, 3 tab, 28 ref.

Descriptors: *Rainfall, *Radar, *Rain gages, *Measuring instruments, *Data collections, *Meteorological data collection, *Precipitation data, *Remote sensing, *Statistical analysis, *Rainfall penetration, Rainfall infiltration.

A geostatistical approach to areal rainfall estimation using raingage and radar measurements is described. The so-called cokriging method is used to obtain a linear estimator of ground-level rainfall depths by combining gage and radar data under unbiasedness and optimality constraints. The statistical inference of the spatial structure of these two kinds of measurements (required to determine the cokriging system) is discussed in the multi-realization and single-realization context. A simplified version of the cokriging method is then proposed to obtain a more tractable system for practical applications. A validation procedure based on (1) the estimation of reference rainfall depths and (2) the selection of a set of likeness criteria is defined. The reference values are computed in an original way by integrating raingage measurements over radar pixels containing a test raingage using the classical kriging method. The test case deals with a set of 11 daily rainfall events observed in the Paris region by the 10 cm 'Melodi' weather radar system. The available raingage network included 98 stations spread over 20,000 sq km: 69 stations have been used for validation purposes and the remaining 29 for the simplified cokriging operation method. The available radar dataset presents severe limitations for hydrological applications mainly in relation to ground echo effects within a 52 km radius of the radar site. In spite of these unfavorable conditions, the proposed combination method appears to improve slightly the performance of the raw radar data and to exceed that of the classical uniform calibration method. Further application of this method using a more appropriate dataset is necessary to confirm these initial results. (Author's abstract)
W89-00761

CHARGE INDUCED ON A CONDUCTING CYLINDER BY A POINT CHARGE AND ITS APPLICATION TO THE MEASUREMENT OF CHARGE ON PRECIPITATION,
National Center for Atmospheric Research, Boulder, CO.
A. J. Weinheimer.
Journal of Atmospheric and Oceanic Technology JAOTES, Vol. 5, No. 2, p 298-304, April 1988. 5 fig, 1 tab, 17 ref.

Descriptors: *Electrical properties, *Conductivity, *Electrical studies, *Atmospheric physics, *Electrical charge measurement, *Measuring instruments, *Precipitation, Water properties.

The solution of the electrostatic boundary value problem for a point charge inside an infinite cylinder is applied to sensors employed in the measurement of charge on precipitation. With these devices, the charge induced on a cylindrical segment is measured and must then be related to the actual charge on the particle. This induced charge depends upon the axis ratio of the cylindrical segment and upon the location of the point charge. Here the fractional induced charge is computed for a number of cases: (1) point charges at the centers of cylindrical segments of various axis ratios; (2) point charges moving along the axes of cylinders with axis ratios of 0.25, 0.5, 1.0, and 2.0; and (3) charges moving parallel to but off to the axis of a cylinder with an axis ration of 1.0. In addition, the effect of the measuring electronics is computed for certain cases. Numerical results such as these will find application in the design of charge sensors, and in some cases may even suffice for their calibration. (Author's abstract)
W89-00762

LIQUID CLOUDWATER COLLECTION USING MODIFIED MOHNEN SLOTTED RODS,
Colorado Coll., Colorado Springs. Dept. of Chem-

istry.
B. J. Huebert, S. Vanbramer, and K. L. Tschudy.
Journal of Atmospheric Chemistry JATCE2, Vol. 6, No. 3, p 251-263, April 1988. 8 fig, 1 tab, 4 ref.
NSF Atmospheric Chemistry Program Grant ATM-8403049.

Descriptors: *Atmospheric water, *Cloud liquid water, *Clouds, *Data collections, On-site data collections, Meteorological data collections.

Slotted rods were used to collect liquid water from summer stratocumulus clouds during the Dycoms program near San Diego. The rods were mounted on a pylon atop the fuselage of NCAR's Electra. Their collection efficiency (relative to King probe liquid water content measurements) averaged 84 plus or minus 15% after an initial conditioning period. During collection runs in which the average LWC exceeded 0.1 g/cu m, the efficiency averaged 91 plus or minus 12%. The authors have identified several factors necessary to achieve this level of performance. (Author's abstract)
W89-00764

PROVISIONAL DIAGENETIC MODEL FOR PH IN ANOXIC POREWATERS: APPLICATION TO THE FOAM SITE,
British Columbia Univ., Vancouver. Dept. of Oceanography.
For primary bibliographic entry see Field 2J.
W89-00767

COMPARISON OF THE FAUNA RETAINED ON 0.5 MM AND 1.0 MM MESHES FROM BENTHIC SAMPLES TAKEN IN THE BEATRICE OILFIELD, MORAY FIRTH, SCOTLAND,
Field Studies Council, Pembroke (Wales). Oil Pollution Research Unit.
For primary bibliographic entry see Field 2L.
W89-00783

INTERCOMPARISON OF FOUR MIXED LAYER MODELS IN A SHALLOW INLAND SEA,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 2H.
W89-00831

BASIN SEDIMENTATION AND THE GROWTH OF PROGRADING DELTAS,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia).
For primary bibliographic entry see Field 2J.
W89-00832

IDENTIFICATION OF RAINFALL TYPE FROM WEATHER RADAR DATA,
Birmingham Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2B.
W89-00842

COMPARISON OF HIGH-ALTITUDE REMOTE AIRCRAFT MEASUREMENTS WITH THE RADAR STRUCTURE OF AN OKLAHOMA THUNDERSTORM: IMPLICATIONS FOR PRECIPITATION ESTIMATION FROM SPACE,
National Aeronautics and Space Administration, Greenbelt, MD. Lab. for Atmospheric Sciences.
G. M. Heymsfield, and R. Fulton.
Monthly Weather Review MRWEAB, Vol. 116, No. 5, p 1157-1174, May 1988. 22 fig, 1 tab, 21 ref.

Descriptors: *Radiometry, *Lidar, *Radar, *Rainfall, *Aircraft, *Remote sensing, *Meteorological data collection, *Weather data collections, Climatology, Model studies, Thunderstorms, Ice, Clouds, Oklahoma.

Observations of an isolated group of Oklahoma thunderstorms from NASA's high altitude ER-2 aircraft included passive radiometric measurements at frequencies in the microwave (92, 183 GHz), infrared and visible portion of the spectrum from a perspective above the storm top. Direct measurements of cloud top height were also collected using a pulsed lidar instrument. These remote observations are discussed and compared with coincident radar data from the National Severe Storms Laboratory's two Doppler radars and in situ cloud top particle data from the University of North Dakota's Citation aircraft. Reflectivity cores are nearly collocated with cold anomalies in the microwave brightness temperature field. Coldest infrared brightness temperatures, however, are displaced downshear of the convective region in association with the cirrus anvil. Radar and in situ microphysical comparisons support previous theoretical and numerical modeling results which suggest that microwave frequencies are sensitive to the deeper layer of large ice particles in the storm's convective region. The trailing anvil which is comprised of smaller ice particles is transparent at 92 GHz and nearly transparent at 183 GHz. This observation has relevance to spaceborne passive microwave measurements of rainfall. Evolution of the thunderstorm complex is also discussed. The trend of the radar volumetric rain rate correlates well with the trends of minimum 92 GHz brightness temperature and area of the cold brightness temperature region at 92 GHz. The correlation at 183 GHz as well as at the infrared wavelength is not nearly as clear. (Author's abstract)
W89-00844

DIFFERENCES IN THE SPECTRAL CHARACTERISTICS OF BIRCH CANOPIES EXPOSED TO SIMULATED ACID RAIN,
Institute of Terrestrial Ecology, Bangor (Wales). Bangor Research Station.
For primary bibliographic entry see Field 5C.
W89-00849

COMPARISON OF INSTREAM AND LABORATORY METHODS OF MEASURING SEDIMENT OXYGEN DEMAND,
Geological Survey, Rolla, MO. Water Resources Div.
D. C. Hall, and W. R. Berkas.
Water Resources Bulletin WARBAQ, Vol. 24, No. 3, p 571-575, June 1988. 4 fig, 1 tab, 4 ref.

Descriptors: *Bottom sediments, *Streambeds, *Oxygen demand, *Water quality, *Biological oxygen demand, On-site tests, Comparison studies, Testing procedures, Streams, Data aquisition.

Sediment oxygen demand (SOD) was determined at three sites in a gravel-bottomed central Missouri stream by: (1) two variations of an instream method, and (2) a laboratory method. SOD generally was greater by the instream methods, which are considered more accurate, and less by the laboratory method. Disturbing stream sediment did not significantly decrease SOD by the instream method. Temperature ranges of up to 12 C had no significant effect on the SOD. In the gravel-bottomed stream, prudent selection of stream sites and careful placement of chambers to prevent streamwater seepage into the chambers are critical for reliable measurements. SOD rates were dependent on the method; therefore, care should be taken in comparing SOD data obtained by different methods. There is a need for a carefully researched standardized method for SOD determinations. (See also W89-00861) (Author's abstract)
W89-00869

DRY STREAM REACHES IN CARBONATE TERRANES: SURFACE INDICATORS OF GROUND-WATER RESERVOIRS,
Geological Survey, Nashville, TN.
J. V. Brahana, and E. F. Hollyday.
Water Resources Bulletin WARBAQ, Vol. 24, No. 3, p 577-580, June 1988. 2 fig, 1 tab, 8 ref.

Descriptors: *Terrain analysis, *Surface-groundwater relations, *Groundwater reservoir, *Remote sensing, *Geohydrology, *Intermittent streams, *Carbonate rocks, Aquifers, Aerial photography, Infrared imagery, Tennessee.

The method of identifying dry stream reaches in carbonate terrane as surface indicators of potential ground-water reservoirs offers a valuable exploration technique that is more rapid and less expensive than traditional exploration methods involving random test drilling. In areas where dry stream reaches occur, subsurface drainage successfully competes with surface drainage, and sheet-like dissolution openings have developed parallel to bedding creating the ground-water reservoir. The occurrence and hydraulic characteristics of such reservoirs are highly variable, as attested to by the wide range of well yields. Union Hollow in south-central Tennessee is the setting for a case study that illustrates the application of the dry stream reach technique. In this technique, dry stream reach identification is based on two types of readily acquired information: (1) remotely sensed black and white infrared aerial photography; and (2) surface reconnaissance of stream channel characteristics. Test drilling in Union Hollow subsequent to identification of the dry reach proved that a localized ground-water reservoir was present. (Author's abstract)
W89-00870

EXPERIMENTAL MARVIN WINDSHIELD EFFECTS ON PRECIPITATION RECORDS IN LEADVILLE, COLORADO,
Geological Survey, Lakewood, CO.
R. D. Jarrett, and L. W. Crow.
Water Resources Bulletin WARBAQ, Vol. 24, No. 3, p 615-626, June 1988. 12 fig, 2 tab, 3 ref.

Descriptors: *Wind, *Paleohydrology, *Rain gages, *Precipitation, *Colorado, *Data acquisition, *Meterological, Hydrologic data collection, Storm runoff, Rainfall.

An evaluation of the Leadville, Colorado, precipitation records that include a 'reported' record-breaking storm (and flood) at higher elevations in the Rocky Mountains has indicated that the use of an experimental Marvin windshield (designed to decrease the effects of wind on precipitation-gage catchment of snow during winter) resulted in substantially overregistered summer precipitation for 1919 to 1938. The July monthly precipitation for these years was over-registered by an average of 157 percent of the long-term July monthly precipitation at Leadville. The cause of the overregistration of precipitation was the almost 4-foot-top-diameter cone-shaped windshield that had the effect of 'funneling' hail and rain splash into the rain gage. Other nearby precipitation gages, which did not use this Marvin windshield, did not have this trend of increased precipitation for the same period. Streamflow records from the Leadville area also do not indicate an increase in streamflow from 1919 to 1938. The storm of July 27, 1937, considered one of the few, large, intense rainstorms at higher elevations, had a recorded precipitation of total 4.34 inches (4.26 inches in 1 hour). Streamflow-gaging-station records indicate that only 0.09 inch of storm runoff occurred. Paleoflood investigations of channels in the Leadville area and old newspaper accounts also indicate no substantial flood from this storm. This study indicates that the 1937 storm probably totaled about 1.7 inches of precipitation, much of which occurred as hail. (Author's abstract)
W89-00876

SPECIATION STUDIES OF COPPER AND MAGNESIUM IN DUCKWEED EXTRACT USING INTERFACED HPLC AND THERMOSPRAY NEUBULIZER FLAME AA,
Louisiana State Univ., Baton Rouge. Dept. of Chemistry.
For primary bibliographic entry see Field 5D.
W89-00886

BASIC ENCODED MODEL FOR ONE-DIMENSIONAL GROUND WATER SYSTEMS INCORPORATING FIRST-ORDER DEGRADATION KINETICS,
Cook Coll., New Brunswick, NJ. Dept. of Environmental Science.
For primary bibliographic entry see Field 5B.

W89-00888

FINITE ELEMENT COMPUTATION OF SHAPE FACTORS FOR KIRKHAM'S PIEZOMETER TUBE METHOD FOR HYDRAULIC CONDUCTIVITY OF SATURATED SOIL,
Dundee Univ. (Scotland). Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 2G.
W89-00911

ACTIVITY ASSESSMENT IN DRINKING WATER BACTERIOLOGY - A COMPARISON OF METHODS AND POSSIBILITIES,
Kongelige Veterinaer- og Landbohoejskole, Copenhagen (Denmark). Inst. of Veterinary Microbiology and Hygiene.
For primary bibliographic entry see Field 5A.
W89-00928

DETERMINATION OF PHOSPHATE AT LOW CONCENTRATIONS IN SURFACE WATERS BY FLOW-INJECTION ANALYSIS,
Hydrological Research Inst., Pretoria (South Africa).
For primary bibliographic entry see Field 5A.
W89-00931

SIMPLE AND EFFICIENT NEW DESIGN OF THE SUBMERSIBLE STIRRER FOR THE YSI DISSOLVED OXYGEN METER,
National Inst. for Water Research, Congella (South Africa). Natal Regional Lab.
C. G. M. Archibald, M. S. Muller, and A. R. Singh.
Water SA, Vol. 14, No. 3, p 167-169, July 1988. 3 fig, 1 ref.

Descriptors: *Oxygen, *Dissolved oxygen, *Measuring instruments, Meters, Temperature.

A new single-cable design of the submersible stirrer for the YSI oxygen meter (used for measuring temperature and dissolved oxygen in freshwater and saline applications) has been developed. The construction incorporates single components which ensures availability of the instruments to any local YSI users. Several advantages of the new design over the original are listed, including: 1) the unit is constructed of robust material and can be produced at a minimal cost for local components, (2) a removable independent battery supply obviates the necessity for two cables., (3) single cable operation is more efficient and prevents problems of intertwining cables, (4) all components are removable, (5) field operation is reliable and simplified, and (6) good protection is provided in the storage mode. The instrument has been used successfully in field operations and requires minimal maintenance. (Miller-PTT)
W89-00936

MAKING THE MOST OF FIELD-MEASURABLE GROUND WATER QUALITY PARAMETERS,
Hydrolab Corp., Austin, TX.
S. Garner.
Ground Water Monitoring Review GWMRDU, Vol. 8, No. 3, p 60-66, Summer 1988. 1 fig, 32 ref.

Descriptors: *Water analysis, *Groundwater, *Aquifers, *Water sampling, *Field testing, Wells, Water quality, Literature review, Sampling.

A literature review was conducted to find the proper methods for field measurement of primary groundwater quality parameters such as temperature, pH, Eh, electrical conductivity, and dissolved oxygen. It is suggested that these measurements, when made properly, can be used for a number of other purposes besides specifying the basic chemical properties of an aquifer. For instance, these measurements, when made during the purging of a well, can be used to: (1) verify aquifer representation of a sample, (2) detect abnormalities within an aquifer, (3) check laboratory measurements to detect sample deterioration, and (4) prompt further monitoring actions. Electronic sensors are available for reliable field measurement of primary parameters. Measurements should be made continuously in an in-line flow cell that is sealed from the atmosphere. Flow can be provided by a bladder pump dedicated to a single well. Samples for laboratory analysis should be collected when the values of the primary parameters do not vary more than 10% per casing volume pumped. (Miller-PTT)
W89-00939

TRACER TEST ANALYSIS OF ANISOTROPY IN HYDRAULIC CONDUCTIVITY OF GRANULAR AQUIFERS,
Wright State Univ., Dayton, OH. Dept. of Geological Science.
For primary bibliographic entry see Field 2F.
W89-00940

RELIABILITY OF CHEMICAL ANALYSES OF WATER SAMPLES: THE EXPERIENCE OF THE UMTRA PROJECT,
Weston (Roy F.), Inc., Albuquerque, NM.
For primary bibliographic entry see Field 5A.
W89-00941

OXYGEN TRANSFER THROUGH FLEXIBLE TUBING AND ITS EFFECTS ON GROUND WATER SAMPLING RESULTS,
Illinois State Water Survey Div., Champaign. Aquatic Chemistry Section.
For primary bibliographic entry see Field 5A.
W89-00943

SENSITIVITY OF FOUR MONITORING WELL SAMPLING SYSTEMS TO LOW CONCENTRATION OF THREE VOLATILE ORGANICS,
Battelle Pacific Northwest Labs., Richland, WA. Geosciences Dept.
For primary bibliographic entry see Field 5A.
W89-00944

SCREENED AUGER SAMPLING: THE TECHNIQUE AND TWO CASE STUDIES,
Jordan (Edward C.) Co., Inc., Portland, ME.
For primary bibliographic entry see Field 5A.
W89-00945

DISCRETE POINT SAMPLER FOR GROUND WATER MONITORING WELLS,
Oregon Graduate Center, Beaverton. Dept. of Environmental Science and Engineering.
J. R. MacPherson, and J. F. Pankow.
Ground Water Monitoring Review GWMRDU, Vol. 8, No. 3, p 161-164, Summer 1988. 1 fig, 9 ref. USGS Agreement 14-08-001-A-0038.

Descriptors: *Samplers, *Sampling, *Monitoring wells, *Groundwater, *Groundwater pollution, *Wells, *Well water, *Water sampling, Pumping, Organic compounds.

A discrete point sampler has been developed that overcomes disadvantages inherent in several current small-volume samplers. It is designed to obtain groundwater samples after a well has been purged with a pump. It consists of a sample chamber, two ports, and a stopcock for withdrawing sample aliquots. After lowering the sampler into a well, sampling is initiated by pulling on a line that sequentially removes the plugs in the lower and the upper level ports. The sample chamber fills from the bottom port and vents air from the top port. The device is suitable for sampling volatile organic compounds in groundwaters that are not subject to spontaneous bubble degasing. The upper port is sufficiently far above the lower port that none of the water that is sampled is exposed to the vented air. The sample chamber fills in such a way that the water that is taken from the chamber for analysis is not exposed to the headspace in the chamber. (Author's abstract)
W89-00947

MULTIVARIATE PERIODIC ARMA (1,1) PROCESSES,
Genoa Univ. (Italy). Inst. of Hydraulics.
J. D. Salas, and J. T. B. Obeysekera.
Water Resources Research WRERAO, Vol. 24, No. 8, p 1237-1246, August 1988. 5 tab, 24 ref, append. NSF Grant INT-8412739.

Descriptors: *Model studies, *Multivariate analysis, *Regression analysis, *Time series analysis, *Hydrologic models, Parametric hydrology, Hydrologic properties, Hydraulic conductivity.

Simulation of synthetic hydrology time series and forecasting of hydrologic events are usually based on stochastic models; among the various models, autoregressive moving-average (ARMA) models have become quite popular. The main objective of the study on which this paper is to investigate the properties of multivariate periodic ARMA (1,1) processes. Such properties include the covariance structure, the parameter space, and estimation. The parameter space of such periodic processes is derived by aggregation (for instance, monthly models will aggregate to annual models). In particular, the parameter space and estimation are analyzed for contemporaneous ARMA (CARMA) models. It was shown that in general, the aggregation of a multivariate periodic ARMA(1,1) model leads to a stationary multivariate ARMA(1,1) model. However, a periodic CARMA(1,1) model did not always aggregate into a stationary CARMA(1,1) model. Furthermore, it was shown that, in estimating the aggregated model parameters, the method based on the periodic model and corresponding parameters was superior to that based on the aggregated series. (Author's abstract)
W89-00967

COMPARISON OF TWO METHODS FOR SUMMARIZING HYDRAULIC CONDUCTIVITIES OF A LAYERED SOIL,
Kansas State Univ., Manhattan. Dept. of Agronomy.
For primary bibliographic entry see Field 2G.
W89-00970

ASSESSING THE BIRKENES MODEL OF STREAM ACIDIFICATION USING A MULTI-SIGNAL CALIBRATION METHODOLOGY,
Senter for Industriforskning, Oslo (Norway).
R. P. Hooper, A. Stone, N. Christophersen, E. de Grosbois, and H. M. Seip.
Water Resources Research WRERAO, Vol. 24, No. 8, p 1308-1316, August 1988. 6 fig, 4 tab, 23 ref, append.

Descriptors: *Acid streams, *Water pollution effects, *Birkenes model, *Calibrations, *Model studies, *Acid rain, Chemical analysis, Water analysis, Hydrologic models, Stream pollution. Prediction, Reservoirs, Hydrography, Tracers, Routing, Rainfall-runoff relationships, Model studies.

A revision of the Birkenes model of streamwater acidification has been attempted to incorporate additional chemical and hydrologic information gained in the last 6 years since its original construction. The first stage of this effort has been an analysis of the hydrologic submodel with the goal of extending it to predict concentrations of a conservative tracer in streamwater. An objective calibration of the model indicated that the model is overparameterized. Only one passive store is identifiable, not two as currently contained in the model and the routing between the two reservoirs is not determined by the data. Inclusion of the conservative tracer improved the identifiability of the dimensional parameters, but had little effect on the rate or routing parameters. If the hydrologic structure is to be determined from the hydrograph and conservative tracer alone, it must be simplified to eliminate unidentifiable parameters. The validity of using more complex rainfall-runoff models in hydrochemical models that seek to test chemical mechanisms is called into question by this analysis. (See also W89-00973) (Author's abstract)
W89-00974

CONTAMINANT TRANSPORT IN FRACTURED POROUS MEDIA: STEADY STATE SO-

LUTIONS BY A BOUNDARY INTEGRAL METHOD,
Melbourne Univ., Parkville (Australia). Dept. of Mathematics.
For primary bibliographic entry see Field 5B.
W89-00982

IMPROVED METHODOLOGY FOR A COLLINEAR DUAL-ENERGY GAMMA RADIATION SYSTEM,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
R. Stillwater, and A. Klute.
Water Resources Research WRERAO, Vol. 24, No. 8, p 1411-1422, August 1988. 5 fig, 1 tab, 22 ref.

Descriptors: *Soil moisture meters, *Radioactivity techniques, *Gamma radiation, *Soil water, Calibrations, Soil density, Radioisotopes, Cesium radioisotopes, Chemical analysis, Precision, Density, Measuring instruments.

Improved procedures are presented for the measurement of water content and soil bulk density using a collinear 241Am and 137Cs gamma radiation system. More accurate procedures than those previously available are offered to correct the americium count rate for dead time and Compton-scattered cesium radiation. Procedures are also presented for the direct measurement of system dead times, based on single-channel analyzer control of dead time. The concept of a maximum system processing rate is discussed, particularly emphasizing its implications for the theoretically achievable measurement precision using available technology. A calibration procedure is offered to improve this precision, by reducing or eliminating the highest (empty cell) count rate from the calibration procedure. To also improve the theoretical system precision, the optimal range of the ratio of correct americium to cesium count rates is found. A method is presented for determining the actual precision and accuracy of measurements. (Author's abstract)
W89-00985

MACROHYDROLOGY: THE NEW CHALLENGE FOR PROCESS HYDROLOGY,
National Aeronautics and Space Administration, Greenbelt, MD. Hydrological Sciences Branch.
For primary bibliographic entry see Field 2A.
W89-01012

REMOTE SENSING IN HYDROLOGY,
Ruhr Univ., Bochum (Germany, F.R.). Inst. for Hydrology, Water Resources and Environmental Engineering.
For primary bibliographic entry see Field 2A.
W89-01019

SIMPLE, RELIABLE, AND INEXPENSIVE PORE-WATER SAMPLER,
Skidaway Inst. of Oceanography, Savannah, GA.
R. A. Jahnke.
Limnology and Oceanography LIOCAH, Vol. 33, No. 3, p 483-487, May 1988. 2 fig, 12 ref. NSF Grant OCE 87-96328.

Descriptors: *Interstitial water, *Sampling, *Water sampling, *Cores, Sediments, Sample preparation, Water analysis.

A simple technique for extracting pore water from sediment cores has been developed. The overall concept of this procedure is to gently pressurize an intact sediment subcore, forcing the pore fluids to be expelled through sampling ports located at specific depths in the core barrel wall. Although this technique does not necessarily improve the integrity of the sample obtained for most solutes, it is much easier to perform than previously reported procedures. Because this technique does not require the sediments to be sectioned into sampling intervals before pore-water extraction, it is rapid and eliminates the need for walk-in cold vans, specialized equipment such as sediment squeezers, high-speed centrifuges and gimbals, and glove bags (for sampling anoxic sediments). (Author's abstract)
W89-01051

GAS CHROMATOGRAPHIC-MASS SPECTROMETRIC INVESTIGATIONS ON LIPOPHILIC ANTHROPOGENIC SUBSTANCES IN ENVIRONMENTAL SAMPLES. II: A SPLITTER FOR THE SIMULTANEOUS DETECTION OF CAPILLARY GAS CHROMATOGRAMS BY UP TO FOUR DIFFERENT GC-DETECTORS,
Biologische Anstalt Helgoland (Germany, F.R.)
For primary bibliographic entry see Field 5A.
W89-01086

DETERMINATION OF THIRAM IN WATER AND SOILS BY CATHODIC STRIPPING VOLTAMMETRY BASED ON ADSORPTIVE ACCUMULATION,
Universidad Autonoma de Madrid (Spain). Dept. de Quimica.
For primary bibliographic entry see Field 5A.
W89-01087

MICROBIAL CHARACTERIZATION OF MUNICIPAL WASTEWATER AT A SPRAY IRRIGATION SITE: THE LUBBOCK INFECTION SURVEILLANCE STUDY,
Texas Univ. at Austin. Dept. of Microbiology.
B. E. Moore, D. E. Gamann, C. A. Turk, and C. A. Sorber.
Journal - Water Pollution Control Federation JWPFA5, Vol. 60, No. 7, p 1222-1230, July 1988. 1 fig, 9 tab, 13 ref. EPA assistance agreements CR 807501 and S 806204.

Descriptors: *Land disposal, *Municipal wastewater, *Bacteria, *Wastewater treatment, *Viruses, *Pathogens, Bacteriophage.

The objective of the Lubbock Infection Surveillance Study (Texas) was to identify possible adverse effects on human health from slow-rate land application of wastewater. During a three year study, wastewater applied to a 1478-m site from either the transit pipeline or on-site storage reservoirs was analyzed for indicator bacteria, bacteriophages, enteric viruses, and selected physical and chemical parameters. Irrigation wastewater used before reservoir completion has a composition equivalent to a typical medium strength untreated wastewater with fecal coliform levels exceeding 1,000,000/100 ml and virus levels ranging from 100 to 1000 pfu/L. Impoundment of this wastewater reduced coliform levels by as much as 99% and lowered viral levels to < 10 pfu/L. (Author's abstract)
W89-01124

MICROCOMPUTER-BASED MEASUREMENT OF ALGAL FLUORESCENCE AS A POTENTIAL INDICATOR OF ENVIRONMENTAL CONTAMINATION,
Waterloo Univ. (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 5A.
W89-01157

COMPARISON OF CHEMICAL BIODEGRADATION RATES IN BOD DILUTION AND NATURAL WATERS,
Wisconsin Univ.-Superior. Center for Lake Superior Environmental Studies.
For primary bibliographic entry see Field 5B.
W89-01158

IS WATER A RELEVANT SAMPLING MEDIUM FOR TOXIC CHEMICALS: AN ALTERNATIVE ENVIRONMENTAL SENSING STRATEGY,
National Water Research Inst., Burlington (Ontario).
For primary bibliographic entry see Field 5A.
W89-01162

USE OF HYDROGEOCHEMICAL SAMPLING DATA IN HYDRAULIC ENGINEERING,
For primary bibliographic entry see Field 2F.
W89-01178

ULTRASONIC FLOWMETER FOR TESTING UNITS OF LARGE HYDROELECTRIC AND PUMPED-STORAGE STATIONS,
For primary bibliographic entry see Field 8C.
W89-01181

MONITORING OF LIQUID EFFLUENTS AS PREVENTATIVE PROTECTION OF NATURAL BODIES OF WATER (ABWASSERUBERWACHUNG ALS VORBEUGENDER GEWASSERSCHUTZ),
BASF A.G., Ludwigshafen am Rhein (Germany, F.R.). Zentralbereich Ingenieurtechnik Fachkonstruktion.
For primary bibliographic entry see Field 5G.
W89-01184

GENERAL CORRECTION FOR SPONTANEOUS POTENTIAL WELL LOGS IN FRESH WATER,
Missouri Univ.-Rolla. Dept. of Geological Engineering.
C. L. McConnell.
Journal of Hydrology JHYDA7, Vol. 101, No. 1-4, p 1-13, June 30, 1988. 3 fig, 1 tab, 11 ref, append.

Descriptors: *Borehole geophysic, *Spontaneous potential, *Electrical well logging, *Groundwater, *Ions, *Computer programs, *Resistivity, *Well logs, Salinity, Suspended Solids, Brines, Chemical properties.

A generalized empirical relationship was found which corrects spontaneous potential (SP) readings from well logs run in fresh water wells. The function was found by correlating measured and calculated spontaneous potentials. The calculated values are based on actual measured ionic content of groundwaters and are fully corrected for environmental effects and ion species. Without the empirical relationship the resistivity R (we) electrically equivalent to an NaCl solution is generally too low for fresh waters when computed with existing commercially available functions. The low R(we) makes the water appear saltier than it really is. One hundred sixty-two individual formations from one hundred four different shallow well logs from widely separated regions of the United States and different types of aquifers were examined. Each formation used in the study had to have a spontaneous potential, mud resistivity data, a chemical analysis of water from the zone, and not be in communication with other zones. Every SP had the existing commercially available geometric corrections applied. A computer program was developed which computes a simulated SP from the chemical analysis and mud data. This simulated SP was plotted against the measured SP. The resulting relationship is given by: measured SP = 0.3782 times simulated SP + 6.9172 for 0 mv < simulated SP < +50 mv. This type of relationship is consistent with earlier work by the author in a localized area. The function can only be applied in fresh waters with simulated SPs in the indicated domain since simulated and measures SPs converge in brine formations. (Author's abstract)
W89-01195

MODELING OF TRACER SPREADING IN A FRACTURE IN WHICH THE APERTURE DECREASES WITH DEPTH IN A LAMINAR FLOW (MODELISATION DE LA PROPAGATION D'UN TRACEUR DANS UNE FRACTURE QUI SE FERME PROGRESSIVEMENT EN PROFONDEUR DANS L'HYPOTHESE D'UN ECOULEMENT LAMINAIRE PARALLELE),
Lille-1 Univ., Villeneuve d'Ascq (France). Lab. de Geologie Appliquee.
For primary bibliographic entry see Field 2F.
W89-01214

DETERMINATION OF MICROBIAL KINETIC COEFFICIENTS THROUGH MEASUREMENT OF INITIAL RATES BY RADIOCHEMICAL TECHNIQUES,
Houston Univ., TX. Environmental Engineering Program.
For primary bibliographic entry see Field 5D.

W89-01218

MODELING BLUE-GREEN ALGAL BLOOMS IN THE LOWER NEUSE RIVER,
Virginia Univ., Charlottesville. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5C.
W89-01225

LAKE RESPONSE MODELING USING BIOLOGICALLY AVAILABLE PHOSPHORUS,
For primary bibliographic entry see Field 5C.
W89-01236

FATE AND TRANSPORT OF ORGANICS IN SOIL: MODEL PREDICTIONS AND EXPERIMENTAL RESULTS,
Utah State Univ., Logan. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W89-01239

VALUE OF STOCHASTIC STREAMFLOW MODELS IN OVERYEAR RESERVOIR DESIGN APPLICATIONS,
For primary bibliographic entry see Field 2E.
W89-01244

MAXIMUM ENTROPY SPECTRAL ANALYSIS OF HYDROLOGIC DATA,
North Dakota State Univ., Fargo. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W89-01248

NUMERICAL TRANSPORT MODEL FOR OXYGEN- AND NITRATE-BASED RESPIRATION LINKED TO SUBSTRATE AND NUTRIENT AVAILABILITY IN POROUS MEDIA,
Auburn Univ., AL. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W89-01251

DETERMINING MICROWAVE BRIGHTNESS TEMPERATURES FROM PRECIPITATING HORIZONTALLY FINITE AND VERTICALLY STRUCTURED CLOUDS,
Wisconsin Univ.-Madison. Space Science and Engineering Center.
C. Kummerow, and J. A. Weinman.
Journal of Geophysical Research (D) JGRDE3, Vol. 93, No. 4, p 3720-3728, April 29, 1988. 5 fig, 5 tab, 20 ref.

Descriptors: *Remote sensing, *Rainfall, *Precipitation, *Clouds, *Rainfall rate, Brightness temperature, Microwave radiance, Satellite technology, Model studies, Ice, Liquid hydrometeors.

Microwave radiances that may be measured from satellite-borne radiometers operating at 37 GHz have been computed as a function of rainfall rates from horizontally finite precipitating clouds that contain both ice and liquid hydrometeors. Precipitating ice from the top of the cloud depressed brightness temperatures significantly. Detailed comparison between finite clouds and the equivalent sections between plane-parallel clouds were made. Footprint averaged brightness temperatures from finite clouds deviated considerably from the sectioned plane-parallel approximation, especially for large rain rates. Better agreement is achieved if a plane-parallel source function is used in the finite cloud model. The effect of shape and orientation of the precipitating cells with respect to the satellite has also been considered. The largest errors introduced by the plane-parallel theory besides the footprint-filling errors were encountered when precipitating cells have large fractions of their surface below the freezing level or contain large amounts of ice. (Author's abstract)
W89-01263

7C. Evaluation, Processing and Publication

CALCULATION OF AN ARCH DAM ON THE BASIS OF SOLVING THE THREE-DIMENSIONAL PROBLEM OF THE THEORY OF ELASTICITY AND THEORY OF SHELLS,
For primary bibliographic entry see Field 8A.
W89-00057

MODEL OF ZOSTERA MARINA L. PHOTOSYNTHESIS AND GROWTH: SIMULATED EFFECTS OF SELECTED PHYSICAL-CHEMICAL VARIABLES AND BIOLOGICAL INTERACTIONS,
Virginia Inst. of Marine Science, Gloucester Point.
For primary bibliographic entry see Field 2L.
W89-00130

BIOCHEMICAL MODELS FOR THE HYPOLIMNETIC OXYGEN DEPLETION IN LAKES IMPACTED BY WASTEWATER DISCHARGES: 2. PHYTOPLANKTON BIOMASS MODEL,
McMaster Univ., Hamilton (Ontario). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5C.
W89-00189

STATISTICAL CONSIDERATIONS ASSOCIATED WITH THE USE OF THE HETEROTROPHIC ACTIVITY METHOD FOR ESTIMATING V SUB MAX AND K' FOR AQUATIC ENVIRONMENTS,
Laurentian Univ., Sudbury (Ontario). Dept. of Biology.
C. G. Choquet, G. D. Ferroni, L. G. Leduc, and J. A. Robinson.
Canadian Journal of Microbiology CJMIAZ, Vol. 34, No. 3, p 272-276, March 1988. 5 fig, 3 tab, 13 ref.

Descriptors: *Regression analysis, *Data interpretation, *Statistics, *Model studies, *Microbiological studies, *Kinetics, *Mathematical studies, Heterotrophic bacteria, *Mathematical equations, Microorganisms, Performance evaluation, Monte Carlo method, Prediction.

This article deals with whether linear or nonlinear, ordinary least-squares regression analysis is superior in the estimation of the kinetic parameters V sub max and K' from data sets generated by the Wright-Hobbie heterotrophic activity method. An analysis of variance showed that weighting of data was theoretically required for the optimal estimation of V sub max and K' for both models. However, the magnitude of the parameter estimates was largely independent of the weighting function employed. Monte-Carlo analysis also indicated that the nature of the weighting function did not appreciably affect the parameter estimates, and more importantly, that there was not a strong statistical justification for the use of the nonlinear model over the linear model in the estimation of V sub max and K'. (Author's abstract)
W89-00280

REGRESSION ESTIMATES FOR TOPOLOGICAL-HYDROGRAPH INPUT,
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 2E.
W89-00304

INCIDENCE OF COLIPHAGE IN POTABLE WATER SUPPLIES,
National Research Centre, Cairo (Egypt). Water Pollution Control Lab.
For primary bibliographic entry see Field 5F.
W89-00338

LOCATION-INVARIANT PLOTTING POSITIONS FOR PWM ESTIMATION OF THE PARAMETERS OF THE GEV DISTRIBUTION,
Saint Andrews Univ. (Scotland). School of Mathematical Sciences.
For primary bibliographic entry see Field 2E.
W89-00351

LINEAR ROOT WATER UPTAKE MODEL,
Indian Inst. of Science, Bangalore. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2I.
W89-00353

VERTICAL VARIABILITY OF SOIL PROPERTIES IN A SMALL WATERSHED,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
For primary bibliographic entry see Field 2G.
W89-00354

EVALUATION OF THE 'FUGACITY' (FEQUM) AND THE 'EXAMS' CHEMICAL FATE AND TRANSPORT MODELS: A CASE STUDY ON THE POLLUTION OF THE NORRSUNDET BAY (SWEDEN),
Senter for Industriforskning, Oslo (Norway).
For primary bibliographic entry see Field 5B.
W89-00357

ECOHYDROLOGICAL APPROACH TO FLORAL AND VEGETATIONAL PATTERNS IN ARCTIC LANDSCAPE ECOLOGY,
Rijksinstituut voor Natuurbeheer, Leersum (Netherlands).
For primary bibliographic entry see Field 2H.
W89-00435

PRINCIPAL COMPONENT ANALYSIS OF PRECIPITATION IN THE ADRIATIC-PANNONIAN AREA OF YUGOSLAVIA,
Hydrometeorological Inst. of Croatia, Zagreb (Yugoslavia).
For primary bibliographic entry see Field 2B.
W89-00472

REGIONALIZATION OF DAILY RAINFALL IN KENYA BY MEANS OF COMMON FACTOR ANALYSIS,
Lund Univ. (Sweden). Dept. of Physical Geography.
For primary bibliographic entry see Field 2B.
W89-00473

MODIFIED FICKIAN MODEL FOR SOLUTE UPTAKE BY RUNOFF,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Mining, Environmental and Geological Engineering.
For primary bibliographic entry see Field 5B.
W89-00486

RIVER BASIN WATER QUALITY MANAGEMENT IN STOCHASTIC ENVIRONMENT,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Industrial Engineering and Management.
For primary bibliographic entry see Field 5G.
W89-00490

ADVENTURES IN HOLISTIC ECOSYSTEM MODELLING: THE CUMBERLAND BASIN ECOSYSTEM MODEL,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia). Marine Ecology Lab.
For primary bibliographic entry see Field 2L.
W89-00675

DISPERSION IN HETEROGENEOUS POROUS MEDIA: 1, LOCAL VOLUME AVERAGING AND LARGE-SCALE AVERAGING,
Washington State Univ., Pullman. Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 5B.
W89-00699

DISPERSION IN HETEROGENEOUS POROUS MEDIA: 2. PREDICTIONS FOR STRATIFIED AND TWO-DIMENSIONAL SPATIALLY PERIODIC SYSTEMS,
Washington State Univ., Pullman. Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 5B.
W89-00700

OPTIMIZATION MODEL FOR SCREENING MULTIPURPOSE RESERVOIR SYSTEMS,
Utah Univ., Salt Lake City. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W89-00703

ANALYSES OF EQUATIONS FOR FREE WATER EVAPORATION ESTIMATES,
Wyoming Univ., Laramie. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2D.
W89-00705

MULTIDIMENSIONAL MODELING OF CUMULATIVE RAINFALL: PARAMETER ESTIMATION AND MODEL ADEQUACY THROUGH A CONTINUUM OF SCALES,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2B.
W89-00706

DISTRIBUTED PARAMETER APPROACH FOR EVALUATING THE ACCURACY OF GROUNDWATER MODEL PREDICTIONS: 1. THEORY,
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab.
For primary bibliographic entry see Field 2F.
W89-00711

DISTRIBUTED PARAMETER APPROACH FOR EVALUATING THE ACCURACY OF GROUNDWATER MODEL PREDICTIONS: 2. APPLICATION TO GROUNDWATER FLOW,
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab.
For primary bibliographic entry see Field 2F.
W89-00712

COMPARISON OF ROBUST BAYES AND CLASSICAL ESTIMATORS FOR REGIONAL LAKE MODELS OF FISH RESPONSE TO ACIDIFICATION,
Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
For primary bibliographic entry see Field 5C.
W89-00713

THREE-DIMENSIONAL RADIAL DISPERSION IN A VARIABLE VELOCITY FLOW FIELD,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 5B.
W89-00715

USE OF MAP ANALYSIS TO ELUCIDATE FLOODING IN AN AUSTRALIAN RIPARIAN RIVER RED GUM FOREST,
Melbourne Univ., Parkville (Australia). Forestry Section.
For primary bibliographic entry see Field 2E.
W89-00722

MAXIMUM LIKELIHOOD CRITERION FOR USE WITH DATA COLLECTED AT UNEQUAL TIME INTERVALS,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 2E.
W89-00723

EVALUATION OF A HOMOGENEOUS POINT PROCESS DESCRIPTION OF ARIZONA THUNDERSTORM RAINFALL,
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab.
For primary bibliographic entry see Field 2B.
W89-00724

EXTENSION OF THE FUJITA SOLUTION TO AIR AND WATER MOVEMENT IN SOILS,
University Coll., Dublin (Ireland). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2G.
W89-00725

STEADY UNSATURATED SEEPAGE ABOVE A SLOPING IMPERMEABLE BASE,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics.
For primary bibliographic entry see Field 2G.
W89-00726

ANNUAL FLOW STATISTICS FOR UNGAGED STREAMS IN IDAHO,
Idaho Univ., Moscow. Dept. of Civil Engineering.
D. R. Horn.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 114, No. 3, p 463-475, August 1988. 9 fig, 3 tab, 3 append.

Descriptors: *Statistical analysis, *Idaho, *Streamflow, *Water level, *Hydrologic data collections, *Flow measurement, *Ungaged streams, *Regression analysis, *Statistical methods, *Flow characteristics, *Flow rates, Mathematical studies, Flood peak, Streamflow forecasting, Hydrologic maps, Regression analysis, Precipitation, Forest hydrology, Stream gages.

Annual streamflow records for 124 stream gages in and near Idaho are examined to determine four annual flow statistics: the mean; the standard deviation; the skew coefficient; and first-order serial correlation coefficient. Using step-wise regression analysis, the mean and standard deviation are related to the basin characteristics of drainage area, mean annual precipitation, and percent forest cover, with the data regionalized geographically. Two sets of equations for north-central and southern Idaho provide the best predictive results, with the equations for north-central Idaho yielding multiple correlation coefficients in excess of 0.97. For the skew and serial correlation coefficients, maps of generalized regional values are prepared by the application of kriging theory, with the resulting maps illustrating the spatial variability of these statistics. The developed equations and maps can be used to estimate annual flow statistics at ungaged locations throughout the state. (Author's abstract)
W89-00753

SATELLITE DATA AND GEOGRAPHICAL INFORMATION SYSTEM FOR LAND USE CLASSIFICATION,
Florida Univ., Gainesville. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 7B.
W89-00756

NONPARAMETRIC APPROACHES TO ENVIRONMENTAL IMPACT ASSESSMENT,
Waterloo Univ. (Ontario). Dept. of Systems Design Engineering.
K. W. Hipel.
Water Resources Bulletin WARBAQ, Vol. 24, No. 3, p 487-492, June 1988. 1 tab, 24 ref.

Descriptors: *Data interpretation, *Environmental impact, *Trend analysis, *Nonparametric testing, *Water quality, *Environmental effects, Model studies, Time series analysis, Estimating, Simulation analysis.

The interesting developments in nonparametric testing and estimation methods presented in a sequence of nine papers are evaluated and compared. Because a deterioration in water quality constitutes a direct threat to human health, it is of utmost importance to have flexible nonparametric methods available for detecting and describing trends in water quality time series. A distinct advantage of nonparametric tests is that they are usually very effective when applied to 'messy' environmental data which may, for example, contain many missing observations and not be normally distributed. By applying their enhanced approaches for nonparametric methods to water quality time series, as well as employing well-designed simulation experiments, the authors of the papers clearly demonstrate the efficacy of utilizing nonparametric tests in environmental impact assessment. (See also W89-00862 thru W89-00869) (Author's abstract)
W89-00861

STATISTICAL METHODS AND SAMPLING DESIGN FOR ESTIMATING STEP TRENDS IN SURFACE-WATER QUALITY,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 7A.
W89-00862

MULTIVARIATE NONPARAMETRIC TESTS FOR TREND IN WATER QUALITY,
Washington Univ., Seattle. Dept. of Civil Engineering.
D. P. Lettenmaier.
Water Resources Bulletin WARBAQ, Vol. 24, No. 3, p 505-512, June 1988. 5 fig, 16 ref.

Descriptors: *Nonparametric tests, *Water quality, *Multivariate analysis, *Trend analysis, *Data interpretation, *Time series analysis, Monitoring, Statistical analysis, Hydrologic data collections, Path of pollutants.

National and state fixed station stream quality monitoring networks have now been in existence for over ten years. The resulting data bases provide opportunities and challenges for statistical trend assessment. Although nonparametric tests have been developed that are well suited to such problems, the interpretation of variations in trend significance between seasons and variables remains a problem. One recently developed test is based on the sum of Mann-Kendall statistics over seasons or variables, with the test statistic variance computed as the sum of the covariances of the individual Mann-Kendall statistics. In this method, uptrends and downtrends can cancel, giving an overall indication of no trend. A related test which is sensitive to trend regardless of direction has been shown to behave poorly for typical stream quality record lengths. An alternative formulation which is sensitive to uptrends and downtrends and has power approaching that of the covariance sum method, is described. In addition, a variation of a contrast test for discriminating trend directions and magnitudes among variables or seasons where correlation between seasons or variables is present is described, and tests of its performance reported. (See also W89-00861) (Author's abstract)
W89-00863

PARAMETRIC AND NONPARAMETRIC TESTS FOR DEPENDENT DATA,
National Water Research Inst., Burlington (Ontario).
A. H. El-Shaarawi, and E. Damsleth.
Water Resources Bulletin WARBAQ, Vol. 24, No. 3, p 513-519, June 1988. 2 fig, 3 tab, 4 ref.

Descriptors: *Nonparametric tests, *Parametric tests, *Data interpretation, *Statistical methods, *Correlation analysis, Hydrologic data collections, Path of pollutants, Niagara River, Statistical analysis, Simulation analysis.

Simulation and analytical results show that ignoring serial dependence can have serious effects on the performance of the t, sign, and Wilcoxen tests. In particular, the true significance levels of these tests are altered significantly from the intended nominal levels. Modification for these tests are given and shown to have the correct significance levels. Furthermore, an estimate of serial correla-

tion is suggested for binary data and evaluated by simulation. The toxic contaminants data used as an example were collected on a weekly basis, from the head and the mouth of the Niagara River, for 37 weeks starting on October 3, 1984 were below the level of detection. Serial correction was used to evaluate the difference between the two stations. (See also W89-00861) (Author's abstract)
W89-00864

TAU-LIKE TEST FOR TREND IN THE PRESENCE OF MULTIPLE CENSORING POINTS,
Washington Univ., Seattle. Dept. of Biostatistics.
J. P. Hughes, and S. P. Millard.
Water Resources Bulletin WARBAQ, Vol. 24, No. 3, p 521-531, June 1988. 4 fig, 7 tab, 22 ref, append.

Descriptors: *Water quality, *Data interpretation, *Trend analysis, *Statistical methods, *Detection limits, Censoring points, Data analysis, Nonparametric testing, Statistical analysis.

A common problem arises in testing for trends in water quality when observations are reported as 'less than detection limit'. If a single detection limit is used for the entire study, existing nonparametric statistical methods, modified for ties, are applicable. If, however, the detection limit varies during the course of the study, resulting in multiple detection limits, then the commonly used trend detection methods are not appropriate. A statistic similar to Kendall's tau, but based on expected ranks, is proposed. Monte Carlo simulations show that the normal approximation to the distribution of this statistic is quite good, even for small samples and a large proportion of censored observations. The statistic is also shown to have greater power than the ad-hoc method of treating all observations less than the target censored observation as tied. (See also W89-00861) (Author's abstract)
W89-00865

DATA ANALYSIS OF WATER QUALITY TIME SERIES IN LAKE ERIE,
Waterloo Univ. (Ontario). Dept. of Systems Design Engineering.
K. W. Hipel, A. I. McLeod, and R. R. Weiler.
Water Resources Bulletin WARBAQ, Vol. 24, No. 3, p 533-544, June 1988. 6 fig, 4 tab, 25 ref.

Descriptors: *Water quality, *Time series analysis, *Lake Erie, *Data interpretation, *Lakes, *Statistical analysis, Nonparametric testing, Parametric hydrology, Environmental effects.

A comprehensive data analysis study is carried out for detecting trends and other statistical characteristics in water quality time series measured in Long Point Bay, Lake Erie. In order to glean an optimal amount of useful information from the available data, the exploratory and confirmatory data analysis stages are adhered to. To test a range of hypotheses regarding the statistical properties of the time series, a wide variety of both parametric and nonparametric techniques are employed. To demonstrate clearly the efficacy of employing nonparametric and also parametric methods in a complex environmental impact assessment study, the effects of industrial development upon water quality in Long Point Bay in Lake Erie, are systematically examined. A particularly useful nonparametric method for discovering trends is the seasonal Mann-Kendall test. It is used to check for the presence of trends in a range of water quality variables at different sites. (See also W89-00861) (Author's abstract)
W89-00866

NONPARAMETRIC TESTS FOR TREND DETECTION IN WATER QUALITY TIME SERIES,
Quebec Ministere de l'Environnement, Sainte-Foy. Direction de la Qualite du Milieu Aquatique.
D. Berryman, B. Bobee, D. Cluis, and J. Haemmerli.
Water Resources Bulletin WARBAQ, Vol. 24, No. 3, p 545-556, June 1988. 4 fig, 6 tab, 33 ref.

Descriptors: *Data interpretation, *Trend analysis, *Nonparametric tests, *Water quality, *Time series analysis, *Statistical analysis, Statistical methods, Hydrologic data collections, Seasonal variation, Canada.

A review of nonparametric tests for trends leads to the conclusion that Mann-Whitney, Spearman, and Kendall tests are the best choice for trend detection in water quality time series. Recently these tests have been adapted to account for dependence and seasonality in such series. For monotonic trends, a procedure allowing one to select the pertinent tests considering the characteristics of time series is proposed and the practical limitations of the tests are also brought out. This procedure has been applied to identification of the appropriate trend detection test for the time series of nine water quality parameters at Lake Laflamme (Quebec). When a time series can be tested with the Mann-Whitney, Kendall, Spearman, or Lettenmaier test, the number of observations required to detect trends of a given magnitude, for selected significance and power levels can be calculated with the power function of the t test. When the tests proposed by Hirsch, Slack, and Smith; Hirsch and Slack; or Farrell need to be used, the number of observations can only be estimated approximately from the results of empirical power studies. (See also W89-00861) (Author's abstract)
W89-00867

TRENDS IN LEAD CONCENTRATIONS IN MAJOR U.S. RIVERS AND THEIR RELATION TO HISTORICAL CHANGES IN GASOLINE-LEAD CONSUMPTION,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 5B.
W89-00868

CONFIDENCE INTERVALS FOR FLOOD EVENTS UNDER A PEARSON 3 OR LOG PEARSON 3 DISTRIBUTION,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
F. Ashkar, and B. Bobee.
Water Resources Bulletin WARBAQ, Vol. 24, No. 3, p 639-650, June 1988. 1 fig, 5 tab, 24 ref, append.

Descriptors: *Confidence intervals, *Data interpretation, *Frequency distribution, *Floods, *Pearson distributions, *Flood frequency, Frequency analysis, Design floods, Mathematical analysis.

The Pearson type 3 (P3) and log Pearson type 3 (LP3) distributions are very frequently used in flood frequency analysis. Existing methods for constructing confidence intervals for quantiles (X sub p) of these two distributions are very crude. Most of these methods are based on the idea of adjusting confidence intervals for quantiles Y sub p or the normal distribution to obtain approximate confidence intervals for quantiles X sub p of the P3/LP3 distribution. Since there is no theoretical reason why this 'base' distribution, Y, should be taken to be normal, the best possible base distribution for producing confidence intervals for P3/LP3 quantiles was sought. A group of base distributions such as the normal, log normal, Weibull, Gumbel, and exponential was considered. It was first assumed that the skew coefficient, gamma of X, was known, and a method for adjusting confidence intervals for Y sub p to produce approximate confidence intervals for X sub p was developed. Then this method (Method A) was compared with another method (Method B) introduced by Stedinger. Simulation showed that the performance of each of these two methods depended on the base distribution Y that was being used, but as a whole, the normal distribution appeared to be the best-fit distribution for producing confidence intervals for P3/LP3 quantiles when gamma was assumed to be known. Then method was then extended (Method A) to the more important case of unknown coefficient of skewness. It was shown that by taking Y to be Weibull, fairly accurate confidence intervals for P3/LP3 quantiles coulb be obtained for quite a wide range of sample sizes and coefficients of skewness commonly found in hydrology. The case of the P3 distribution with negative skewness needs further research. (Author's abstract)
W89-00879

DEVELOPING AND ASSESSING A MODEL OF RESIDENTIAL WATER CONSERVATION,
California Univ., Berkeley. Dept. of Social Administrative Health Services.
For primary bibliographic entry see Field 3D.
W89-00881

SIMULATION OF REGIONAL GROUND WATER FLOW IN BEDROCK, SOUTHWESTERN NEW YORK-NORTHWESTERN PENNSYLVANIA,
Stearns and Wheeler, Cazenovia, NY.
For primary bibliographic entry see Field 2F.
W89-00882

CATALYST FOR REGIONALIZATION OF RURAL WATER SYSTEMS,
Louisville Univ., KY. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6E.
W89-00883

PROGRESS IN DEVELOPING AN OPERATIONAL SNOWMELT-RUNOFF FORECAST MODEL WITH REMOTE SENSING INPUT,
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
For primary bibliographic entry see Field 2A.
W89-00891

MODELLING THE EFFECTS OF ACID DEPOSITION: ESTIMATION OF LONG-TERM WATER QUALITY RESPONSES IN FORESTED CATCHMENTS IN FINLAND,
National Board of Waters, Helsinki (Finland). Water Research Inst.
For primary bibliographic entry see Field 5B.
W89-00894

CHEMISTRY AND DELTA 13C OF TOTAL DISSOLVED CARBON IN WATERS OF SELECTED SPRINGS NEARBY LUBLIN CITY: WEEKLY OBSERVATIONS FROM OCTOBER 1982 TO JUNE 1983,
Marie Curie-Sklodowska Univ., Lublin (Poland).
For primary bibliographic entry see Field 2F.
W89-00895

EXTREME PRESSURES IN HYDRAULIC-JUMP STILLING BASINS,
QIT-Fer et Titane, Inc., Montreal (Quebec).
For primary bibliographic entry see Field 8B.
W89-00896

FRICTION FACTOR EVALUATION IN GRAVEL-BED RIVERS,
Universita di Reggio Calabria, Cosenza (Italy). Dipt. di Difesa del Suolo.
For primary bibliographic entry see Field 8B.
W89-00898

GENERALIZED METHOD OF MOMENTS APPLIED TO LP3 DISTRIBUTION,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
For primary bibliographic entry see Field 2E.
W89-00901

GROUNDWATER VELOCITY MAGNITUDE IN RADIONUCLIDE TRANSPORT CALCULATIONS,
For primary bibliographic entry see Field 5B.
W89-00903

STREAM NITRATE LEVELS IN A SMALL CATCHMENT IN SOUTH WEST ENGLAND OVER A PERIOD OF 15 YEARS (1970 - 1985),
Oxford Univ. (England). Geography School.
For primary bibliographic entry see Field 5B.
W89-00915

ASSESSING THE INFLUENCE OF ENVIRONMENTAL PARAMETERS ON THE HYDROLOGICAL CYCLE,
General Hydrological Station of Anhui Province (China).
For primary bibliographic entry see Field 2A.
W89-00916

USE OF NETWORK ANALYSIS TECHNIQUES IN THE DEVELOPMENT AND OPTIMIZATION OF A LARGE UK URBAN WATER DISTRIBUTION SYSTEM (L'EMPLOI DE TECHNIQUES),
Parkman Consulting Engineers, Liverpool (England).
For primary bibliographic entry see Field 5F.
W89-00918

DEFINITION OF A MODEL FOR MONITORING THE CHEMICAL AND CHEMICAL-PHYSICAL CHARACTERISTICS OF DEEP DRINKING WATERS,
Perugia Univ. (Italy). Cattedra di Igiene.
A. DeBartolomeo, U. Franconi, F. LaRosa, S. Lupi, and G. Saltalamacchia.
Aqua AQUAAA, No. 3, p 127-132, 1988. 3 fig, 2 tab, 7 ref.

Descriptors: *Model studies, *Water quality, *Water chemistry, *Drinking water, *Groundwater, *Factor analysis, Springs, Wells, Cluster analysis, Italy, Chemical properties, Physiochemical properties.

A probabilistic model was used for the chemical and chemical-physical characterization of deep drinking waters of the Perugia province (Umbria region, Italy). Thirty two parameters were studied and 761 sources were examined (549 springs and 212 wells). Factor analysis applied to several parameters indicated ten factors, but the first three had the greatest share of the variance. In the first factor, the most important parameters were: (1) calcium, (2) hardness (total, temporary and permanent), (3) solid residue, (4) electric conductivity, (5) pH, (6) sulfates, and (7) magnesium. In the second, the most important parameters were: (1) turbidity, (2) suspended substances, and (3) aluminum. In the third, the most important parameters were: (1) potassium, and (2) phosphates. The cluster analysis applied to these parameters confirmed the relationship found by factor analysis except for the pH in the first group and aluminum in the third group. These associations are consistent with the criteria suggested by Italian law and by the E.E.C. Directive for checking drinking waters. Another cluster analysis, applied to several drinking water sources, grouped the samples in three clusters. In the first cluster, there were 407 sources located mainly in the characteristic hills of the Umbria region and in the valleys of the principal rivers. The second group consisted of 310 sources located mainly in the mountains of the Apennines and the third group 36 sources located mainly where the Tiber River valley joins the Umbria valley. The chemical and chemical-physical characters relative to the three clusters are consistent with the geomorphological characteristics of the territories from which the waters came. The application of these multivariate analysis methods for characterizing the deep waters confirms their usefulness in evaluating the chemical and chemical-physical characters and their possible modifications. (Author's abstract)
W89-00927

MODELING CONTAMINANT PROPAGATION IN DRINKING WATER DISTRIBUTION SYSTEMS,
Environmental Protection Agency, Cincinnati, OH. Water Engineering Research Lab.
For primary bibliographic entry see Field 5F.
W89-00929

STASOFT: A USER-FRIENDLY INTERACTIVE COMPUTER PROGRAM FOR SOFTENING AND STABILISATION OF MUNICIPAL WATERS,
Cape Town Univ. (South Africa). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W89-00935

MULTISIGNAL AUTOMATIC CALIBRATION METHODOLOGY FOR HYDROCHEMICAL MODELS: A CASE STUDY OF THE BIRKENES MODEL,
Ontario Ministry of the Environment, Dorchester. Dorset Research Center.
For primary bibliographic entry see Field 5B.
W89-00973

FRACTAL NATURE OF RIVER NETWORKS,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W89-00975

ASSESSMENT OF FLOOD FREQUENCY MODELS USING EMPIRICAL DISTRIBUTION FUNCTION STATISTICS,
Saint Andrews Univ. (Scotland). School of Mathematical Sciences.
For primary bibliographic entry see Field 2E.
W89-00976

ANALYTICAL SOLUTION FOR AQUIFER DECONTAMINATION BY PUMPING,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
For primary bibliographic entry see Field 5G.
W89-00977

GRADIENT DYNAMIC PROGRAMMING FOR STOCHASTIC OPTIMAL CONTROL OF MULTIDIMENSIONAL WATER RESOURCES SYSTEMS,
Iowa State Univ., Ames. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W89-00979

CONTINUUM APPROACH FOR MODELING MASS TRANSPORT IN FRACTURED MEDIA,
Alberta Univ., Edmonton. Dept. of Geology.
For primary bibliographic entry see Field 5B.
W89-00980

NUMERICAL MODELING OF SORPTION KINETICS OF ORGANIC COMPOUNDS TO SOIL AND SEDIMENT PARTICLES,
National Taiwan Univ., Taipei. Inst. of Environmental Engieering.
For primary bibliographic entry see Field 5B.
W89-00981

DRAWDOWN INTERVAL ANALYSIS: A METHOD OF DETERMINING THE PARAMETERS OF SHALLOW CONDUIT FLOW CARBONATE AQUIFERS FROM PUMPING TESTS,
Kentucky Univ., Lexington. Dept. of Geology.
For primary bibliographic entry see Field 2F.
W89-00986

STATISTICAL CORRELATIONS FOR PREDICTING THE PARTITION COEFFICIENT FOR NONPOLAR ORGANIC CONTAMINANTS BETWEEN AQUIFER ORGANIC CARBON AND WATER,
General Motors Research Labs., Warren, MI. Environmental Science Dept.
For primary bibliographic entry see Field 5B.
W89-00992

SPATIAL AND TEMPORAL SCALES IN RAINFALL ANALYSIS SOME ASPECTS AND FUTURE PERSPECTIVES,
Lund Univ. (Sweden). Dept. of Water Resources Engineering.
For primary bibliographic entry see Field 2B.
W89-01021

HILLSLOPE RUNOFF PROCESSES AND MODELS,
Leeds Univ. (England). School of Geography.
For primary bibliographic entry see Field 2A.
W89-01022

RAINFALL-RUNOFF MODELING: PAST, PRESENT AND FUTURE,
Bologna Univ. (Italy).
For primary bibliographic entry see Field 2A.
W89-01023

POTENTIAL IMPORTANCE OF SPATIAL AND TEMPORAL HETEROGENEITY IN PH, AL, AND CA IN ALLOWING SURVIVAL OF A FISH POPULATION: A MODEL DEMONSTRATION,
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5C.
W89-01052

SYSTEM FOR COASTAL DESCRIPTION AND CLASSIFICATION,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia).
A. Fricker, and D. L. Forbes.
Coastal Management CZMJBF, Vol. 16, No. 2, p 111-137, 1988. 9 fig, 7 tab, 16 ref.

Descriptors: *Coastal zone management, *Data collections, *California, *Computer applications, *Coasts, *Mapping, Canada, Case studies, Topology, Geology, Maps, Morphology, Computers, Coasts.

A suitable computer system for coastal information can support management of data collected over several years, easing the problems of organizing and indexing many forms of observational records and helping to improve the standards for coastal classification. The simple topological character of the coast makes it possible to use a one-dimensional model for longitudinal subdivision into quasi-homogeneous segments of any convenient length. This is illustrated with reference to a case-study locality on the Canadian Atlantic coast. Information related to specified sections of the coast is organized as a generalized database. Using commercial database mangement software gives great flexibility and power of application. The chief concession to the geographic and cartographic requirements is the use of a detailed digitalized coastline file, which is linked to the divisions in the main file in order to produce maps as one of several forms of reporting. (Author's abstract)
W89-01071

OCCURRENCE OF RADON, RADIUM, AND URANIUM IN GROUNDWATER,
Environmental Protection Agency, Cincinnati, OH.
For primary bibliographic entry see Field 5B.
W89-01108

COMPOSITE METHOD FOR ESTIMATING ANNUAL ACTUAL EVAPOTRANSPIRATION,
General Hydrological Station of Liaoning Province, Shenyang (China).
For primary bibliographic entry see Field 2D.
W89-01141

DERIVATION OF BASEFLOW RECESSION CONSTANT USING COMPUTER AND NUMERICAL ANALYSIS,
Maiduguri Univ. (Nigeria).
For primary bibliographic entry see Field 2E.
W89-01142

APPROXIMATE CONFIDENCE INTERVALS FOR VERIFICATION CRITERIA OF THE WMO INTERCOMPARISON OF SNOWMELT RUNOFF MODELS,
McGill Univ., Montreal (Quebec). Dept. of Civil Engineering.

For primary bibliographic entry see Field 2E.
W89-01143

PROBLEMS OF RAINFALL-RUNOFF MODELLING IN ARID AND SEMIARID REGIONS,
New South Wales Univ., Kensington (Australia). School of Civil Engineering.
For primary bibliographic entry see Field 2E.
W89-01144

MODALP: A DETERMINISTIC RAINFALL-RUNOFF MODEL FOR LARGE KARSTIC AREAS,
Hacettepe Univ., Ankara (Turkey). Dept. of Hydrogeological Engineering.
For primary bibliographic entry see Field 2F.
W89-01145

INFLUENCE OF ALTITUDE ON WET DEPOSITION: COMPARISON BETWEEN FIELD MEASUREMENTS AT GREAT DUN FELL AND THE PREDICTIONS OF A SEEDER-FEEDER MODEL,
University of Manchester Inst. of Science and Technology (England). Dept. of Pure and Applied Physics.
For primary bibliographic entry see Field 5B.
W89-01147

ACIDIC DEPOSITION DISTRIBUTION AND EPISODE STATISTICS FROM THE MAP3S NETWORK DATABASE,
Battelle Pacific Northwest Labs., Richland, WA. Atmospheric Sciences Dept.
For primary bibliographic entry see Field 5B.
W89-01151

INCREASE OF THE RELIABILITY AND CONVENIENCE OF OPERATION OF THE GROUP ACTIVE POWER REGULATION SYSTEM OF A HYDROELECTRIC STATION,
For primary bibliographic entry see Field 8C.
W89-01179

APPLICATION OF PROBABILITY WEIGHTED MOMENTS IN ESTIMATING THE PARAMETERS OF THE PEARSON TYPE THREE DISTRIBUTION,
Nanjing Hydrological Research Inst. (China).
S. Dedun, and D. Jing.
Journal of Hydrology JHYDA7, Vol. 101, No. 1-4, p 47-61, June 30, 1988. 2 fig, 5 tab, 11 ref, append.

Descriptors: *Pearson distribution, *Statistics, *Flood frequency, *Frequency distribution, *Probability distribution, Mathematical studies, China, Monte Carlo method, Statistical methods, Sampling.

Since 1979, probability weighted moments (PWM) have been used in estimating the parameters of several distributions expressible in inverse forms. The statement has been made, however, that PWM can be used only for distributions whose inverse forms can be explicitly defined. This paper indicates that this is by no means so. PWM can be applied to the estimation of the parameters of the Pearson Type Three distribution (P-III distribution) although this distribution does not have an explicit inverse form. The expressions relating the parameters of the P-III distribution and PWM are derived. Estimators of the parameters of the P-III distribution by PWM, conventional moments, maximum likelihood and curve fitting, as applied in China, are compared. The results of Monte Carlo experiments show that the PWM method compares favorably with the conventional moments method and is almost as efficient as the maximum likelihood and curve fitting methods. (See also W89-01199) (Author's abstract)
W89-01198

DETERMINATION OF PROBABILITY WEIGHTED MOMENTS WITH THE INCORPORATION OF EXTRAORDINARY VALUES INTO SAMPLE DATA AND THEIR APPLICATION TO ESTIMATING PARAMETERS FOR THE PEARSON TYPE THREE DISTRIBUTION,
Chengdu Univ. of Science and Technology (China).
D. Jing, and Y. Rongfu.
Journal of Hydrology JHYDA7, Vol. 101, No. 1-4, p 63-81, June 30, 1988. 3 fig, 4 tab, 7 ref. Ministry of Water Resources and Electrical Power Grant 86028135.

Descriptors: *Pearson distributions, *Statistics, *Frequency distribution, *Probability distribution, *Flood frequency, *Sampling, Statistical methods, China, Mathematical studies.

The formulas for computing probability weighted moments (PWM) in terms of nonsimple samplea (sample with historical flood information) are developed under an assumption whose reasonableness has been verified by statistical experiments. These formulas make the PWM method capable of being applied to estimating parameters of hydrologic frequency distribution when extraordinary values exist in a sample, so that the domain of operation of the PWM method is largely extended. A large number of experimental results has shown that the formulas suggested in this paper are feasible and reasonable. The efficiency and unbiasedness of the parameters and quantities of the Pearson Type Three (P-III) distribution estimated by the PWM method are superior to those estimated by the curve fitting method and are almost the same as those estimated by the maximum likelihood method when the skewness coefficient of the P-III distribution is less than 2.5, and the unbiasedness is better than, but efficiency is similar to, those estimated by the traditional moment method. A lot of flood data observed and investigated at about sixty gauging stations in China have been used to analyze the applicability of the PWM method. The results show that the proposed formulas are most satisfactory. (See also W89-01198) (Author's abstract)
W89-01199

EXTREME-VALUE THEORY MODEL FOR DEPENDENT OBSERVATIONS,
Surrey Univ., Guildford (England). Dept. of Mathematics.
J. A. Tawn.
Journal of Hydrology JHYDA7, Vol. 101, No. 1-4, p 227-250, June 30, 1988. 13 fig, 5 tab, 26 ref, append.

Descriptors: *Statistics, *Extreme-value theory, *Mathematical models, *Time series analysis, *Sea level, Statistical methods, Data interpretation, Stochastic process.

Modelling extreme values from an environmental time series requires an extreme-value theory model which can handle dependent observations. A method of filtering the original time series to obtain independent extremes is presented. The resulting extremes are then modelled using an extension of suggested ideas. Here the limiting joint Generalized Extreme Value distribution for their largest order statistics is considered; whereas others used the corresponding Gumbel distribution. Various tests of fit of the model are discussed, with a detailed analysis of how to test for dependence between extremes in the original sequence. An additional method of using data from neighboring sites to improve the estimation is suggested. The procedures and tests are illustrated by an application to the sea levels at Lowestoft and Great Yarmouth. (Author's abstract)
W89-01208

IDENTIFICATION OF A MULTIPLE INPUT, SINGLE OUTPUT, LINEAR, TIME INVARIANT MODEL FOR HYDROLOGICAL FORECASTING,
University Coll., Galway (Ireland). Dept. of Engineering Hydrology.
G. C. Liang.
Journal of Hydrology JHYDA7, Vol. 101, No. 1-4, p 251-262, June 30, 1988. 4 fig, 2 tab, 12 ref, append.

Descriptors: *Statistical analysis, *Mathematical models, *Flood forecasting, *Rainfall-runoff relationships, *China, Discharge hydrographs, Flood hydrographs, Data interpretation, Regression analysis, Unit hydrographs.

The problem of the numerical instability of a unit hydrograph derived by the least squares method from a complex rainfall-runoff event is well known in hydrology. The same problem, though perhaps less acute, arises in the identification of the pulse response of the single input-single output, linear, time invariant model applied in flood routing or rainfall-runoff modelling. The problem has been handled by other researchers using the ridge regression concept which produces a least squares estimate subject to a constraint expressing the preferred shape of the impulse response. The ridge regression technique is reviewed and applied in the identification of the transformations in a multiple input, single output, linear flow routing model relating four inflow hydrographs to a discharge hydrograph at Hankou on the Changjiang (Yangtze River) in China. It is shown that this method of identification can be interpreted as an ordinary least squares estimation where an uncorrelated white noise component has been added to the input series. (Geiger-PTT)
W89-01209

NEW APPROXIMATE TECHNIQUE FOR THE HODOGRAPH METHOD IN GROUNDWATER FLOW AND ITS APPLICATION TO COASTAL AQUIFERS,
Minnesota Univ., Minneapolis. Dept. of Civil and Mineral Engineering.
For primary bibliographic entry see Field 2F.
W89-01243

MAXIMUM ENTROPY SPECTRAL ANALYSIS OF HYDROLOGIC DATA,
North Dakota State Univ., Fargo. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W89-01248

FACTORS AFFECTING THE EFFICIENCY OF SOME ESTIMATES OF FLUVIAL TOTAL PHOSPHORUS LOAD,
Clarkson Univ., Potsdam, NY. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W89-01249

RELATIVE ROLES OF EMISSIONS CHANGES AND METEOROLOGICAL VARIABILITY OF WET SULFUR DEPOSITION: A TRAJECTORY MODEL STUDY,
Ontario Ministry of the Environment, Toronto. Air Resources Branch.
For primary bibliographic entry see Field 5B.
W89-01259

VERTICALLY INTEGRATED SNOW/ICE MODEL OVER LAND/SEA FOR CLIMATE MODELS: 1. DEVELOPMENT,
Tel-Aviv Univ. (Israel). Dept. of Geophysics and Planetary Sciences.
For primary bibliographic entry see Field 2C.
W89-01260

VERTICALLY INTEGRATED SNOW/ICE MODEL OVER LAND/SEA FOR CLIMATE MODELS: 2. IMPACT ON ORBITAL CHANGE EXPERIMENTS,
Tel-Aviv Univ. (Israel). Dept. of Geophysics and Planetary Sciences.
For primary bibliographic entry see Field 2C.
W89-01261

COMPARISON OF MODEL-GENERATED AND SATELLITE-DERIVED CLOUD COVER AND RADIATION BUDGET,
Lille-1 Univ., Villeneuve d'Ascq (France). Lab. d'Optique Atmospherique.

For primary bibliographic entry see Field 2A.
W89-01262

ASPECTS OF ATMOSPHERIC POLLUTANT ORIGIN AND DEPOSITION REVEALED BY MULTIELEMENTAL OBSERVATIONS AT A RURAL LOCATION IN EASTERN CANADA,
Atmospheric Environment Service, Downsview (Ontario).
For primary bibliographic entry see Field 5B.
W89-01264

8. ENGINEERING WORKS

8A. Structures

CONTROL OF THE CONDITIONS FOR INPUT OF HYDROPOWER INTO THE UNIFIED POWER SYSTEM OF THE U.S.S.R.,
For primary bibliographic entry see Field 8C.
W89-00034

SEISMIC STRESS STATE OF UNDERGROUND STRUCTURES WITH CONSIDERATION OF THE EFFECT OF THE FREE SURFACE,
For primary bibliographic entry see Field 8E.
W89-00035

ASSIGNMENT OF THE CHARACTERISTICS OF CLAY-RUBBLE SOILS IN WATERTIGHT COMPONENTS OF EARTH DAMS,
For primary bibliographic entry see Field 8D.
W89-00036

INTRODUCTION OF NEW TECHNOLOGY ON THE CONSTRUCTION OF THE SHAMKHOR HYDROELECTRIC STATION,
E. V. Aliev, R. A. Gamidov, and A. G. Seidov.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 7, p 414-417, January 1988. 1 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 7, p 26-28, July 1987.

Descriptors: *Construction, *Hydroelectric plants, Earth dams, Design standards, Hydraulic design, Economic efficiency, Spillways, Soviet Union, Hydraulic structures, Hydraulic engineering, Technology.

In hydropower and hydrotechnical construction in Azerbaidzhan (Soviet Union), considerable improvement in the quality of works, reduction of labor and material expenditures, and shortening of construction time are being achieved by using new, technology and the achievements of scientific and technological progress in design studies. The design studies for the Shamkhor hydrostation included investigations of the different variants of the composition and layout of the structures, number and arrangement of the turbine-generator units, site and design of the dams, watertight elements of the earth dams, combined and separate designs of the spillway, and designs and materials of the water conduits. As a result of the development and introduction of rational layouts and designs, a substantial reduction in the construction and assembly works, shortening of the construction time, and reduction of the estimated cost of the structures were achieved. The total economic effect is more than 2 million rubles. The experience in the construction and operation of the hydro development confirmed the high technical and economic effectiveness of the new technologies introduced, and they can be recommended for use when constructing other hydrostations of the middle Kura cascade. (Friedmann-PTT)
W89-00039

USE OF HORIZONTAL DRAINAGE FOR DRAINING DAM SLOPES,
For primary bibliographic entry see Field 8C.
W89-00040

NEW LIFE FOR SMALL HYDROELECTRIC STATIONS IN KIRGIZIA,
For primary bibliographic entry see Field 8C.
W89-00042

50TH ANNIVERSARY OF THE MOSCOW CANAL,
V. V. Bocharov.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 6, p 305-315, December 1987. 5 fig. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 6, p 1-7, June 1987.

Descriptors: *Canal design, *History, *Hydraulic design, *Navigation canals, *Water resources development, *Moscow Canal, Design criteria, Bank erosion, Hydraulic gates, Banks, Soviet Union, Locks, Construction materials.

Construction of the Moscow-Volga Canal began in September 1932, and was finished on time on May 1, 1937. The accomplishment of such construction, carried out by efforts of Soviet specialists under the most difficult hydrogeological conditions entirely from domestic materials and equipment, was an outstanding achievement. It was also completed in an exceptionally short time for such a complex of structures, 4 years and 8 months. Moscow had long been considered a 'dry' city, and had practically exhausted the water resources of the Moscow River by the start of the 1930's. New sources of water supply were needed. The scale and short time of construction induced the canal designers and builders to develop improved designs, use the best types of equipment, and to find and introduce progressive methods of conducting the works. The Moscow Canal is a hydraulic complex operating year round, and its operating season during the past 10 years has been increased to 240-250 days, from the original 180-200 days. The canal has more than 240 different structures. Many of the original structures were designed so well that they correspond to present day requirements in many respects. Thus, the lock constructed with chamber dimensions of 30 x 290 m and with a depth margin on the sill will remain the largest navigation structures constructed on canals for a long time to come. The design quality, reliability of the construction and assembly works of the canal is so high that the canal has functioned reliably during the entire 50 year period. (VerNooy-PTT)
W89-00049

RELIABILITY AND SAFETY INSPECTION OF HYDRAULIC STRUCTURES OF THE MOSCOW CANAL,
V. E. Ni.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 6, p 322-339, December 1987. 7 fig, 1 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 6, p 11-17, June 1987.

Descriptors: *Canals, *Moscow Canal, *Navigation canals, *Locks, *Inspection, Banks, Canal seepage, Cracks, Canal design, Maintenance, Soviet Union.

The navigation, hydropower, and impounding structures of the Moscow Canal, which have been in service for 50 years, operate reliably and continue to implement use of the water resources of the basin of the upper Volga for the water supply of Moscow and the Moscow region, for sanitary supplemental water supply of small rivers, production of electric energy, and hauling freight by water transport. Data on the operation of the main elements of the hydraulic structures and results of special and systematic observations are detailed in this paper. The operation of the watertight elements and the unsteady seepage regimes were studied. Unsteady processes caused by continuing settlement and development of the territory have been observed on the structures during the entire period of operation. Also during this time, the settlements of the chambers did not exceed 50-90 mm and of the lock head 90-110 mm. Defects noted in the chamber walls, such as deformation and cracks are reported. An analysis of the working conditions of the lock chamber walls showed that premature (100 years) worsening of the condition of the the walls, along with design shortcomings, was primarily due to underestimation of elementary phenomena leading to severe working condition of the walls with the course of time. The measures taken in recent years to increase the stability of the structures provide operational reliability at a sufficiently high level. The problems relating mainly to improvement of the technological processes during maintenance works and improvement of the method of estimating the actual strength of the retaining walls require a fundamental solution without delay. (VerNooy-PTT)
W89-00051

SELECTION OF A METHOD FOR COMPUTER-AIDED DESIGN OF EARTH DAMS,
For primary bibliographic entry see Field 8D.
W89-00056

CALCULATION OF AN ARCH DAM ON THE BASIS OF SOLVING THE THREE-DIMENSIONAL PROBLEM OF THE THEORY OF ELASTICITY AND THEORY OF SHELLS,
V. N. Lombardo, and B. V. Fradkin.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 6, p 355-363, December 1987. 6 fig, 1 tab, 9 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 6, p 36-42, June 1987.

Descriptors: *Mathematical analysis, *Arch dams, *Dam design, *Elasticity theory, Computer models, Mathematical studies, Strain, Stress, Finite element method.

Arch dams are often the most economical and reliable types of dams when constructing hydro developments under mountain conditions. In the Soviet Union a number of such dams have been constructed and design studies are carried out in all cases when the construction of arch dams is possible. Therefore, problems of developing reliable methods of estimating their stress-strain state are quite urgent. Several dozen calculation problems have been developed. Here a test problem, the calculation of one of the variants of the arch dam of the Datun Hydroelectric station, is examined. The dam is calculated by two methods: by solving the three-dimensional problem of elasticity theory by the finite element method; and according to the thin-shell theory, by the variate difference method. The differences in the results obtained by any method formulated in the framework of the linearly elastic problem cannot substantially exceed the differences obtained in the given comparative calculation. Methods and programs giving qualitatively different results under the same physical premises should be considered erroneous or defective. It is suggested to use the solution obtained for testing newly developed algorithms and programs for calculating arch dams and for evaluating methods of experimental investigations. (VerNooy-PTT)
W89-00057

FILTERLESS REVETMENT OF THE SLOPES OF DIKES AT PUMPED-STORAGE STATION RESERVOIRS,
V. F. Kanarskii, V. M. Kondrat'ev, and M. N. Rubanik.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 6, p 363-366, December 1987. 1 fig, 1 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 6, p 42-43, June 1987.

Descriptors: *Revetments, *Embankments, *Dikes, *Frost heaving, *Concrete construction, Pumped storage, Design standards, Mathematical models.

The upstream slopes of earth dams made of cohesive soils are protected (winterized) from the danger of cold, particularly frost heaving, by nonheaving sand soil, which in turn is protected from seepage and piping by layers of rubble or gravel reversed filters and concrete. This construction is costly, and requires a lot of work, including the use of a considerable amount of manual labor. However, it is known from practice that a concrete revetment of upstream slopes of dams placed without a winterizing layer and filter bed works just as well as a concrete revetment on a multilayer filter and winterizing bed. The seasonal combined displacements of the soil and concrete slab do not cause any deformations and disturbances in the filterless

revetment of the upstream slope. Experimental investigations were undertaken to determine frost heaving and the effect of heaving on the strength of filterless concrete coverings of heavy loam slopes. During design, frost heaving processes must be investigated in detail under conditions identical to the actual conditions. Proposed methods of taking in to account cryogenic phenomena in designing protective concerning of upstream slopes are subject to refinement. (VerNooy-PTT)
W89-00058

SMALL HYDROELECTRIC STATIONS AND PROSPECTS OF THEIR DEVELOPMENT,
For primary bibliographic entry see Field 8C.
W89-00059

CONCERNING CERTAIN STUDIES ON SEEPAGE AND DISSOLUTION OF SALTS IN THE FOUNDATION OF DAMS,
For primary bibliographic entry see Field 10C.
W89-00062

DEFORMATION OF DAMS WITH A FACING AND THEIR SEISMIC STABILITY,
For primary bibliographic entry see Field 8D.
W89-00070

COMPONENTS OF FORCES OF A RESERVOIR ACTING ON THE FOUNDATION OF HIGH DAMS,
For primary bibliographic entry see Field 8B.
W89-00073

EFFECTIVE COATINGS FOR HYDRAULIC STRUCTURES,
For primary bibliographic entry see Field 8G.
W89-00075

CERTAIN CHARACTERISTICS OF CALCULATING ANGULAR RETAINING WALLS,
V. K. Gol'tsman.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 4, p 243-250, October 1987. 5 fig, 10 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 4, p 54-58, April 1987.

Descriptors: *Retaining walls, *Hydraulic engineering, *Stress analysis, *Model studies, Stress, Strain, Hydraulic structures, Check structures, Engineering, Load distribution.

The calculations of retaining walls in current use are considerably simplified, despite the fact that retaining walls, being three-dimensional, are in a complex stress-strain state, especially in hydraulic structures with a height of 20-30 m and more. A model is presented to investigate some important characteristics in the work of an angular retaining wall. Although the model is somewhat distorted in geometry, it is convenient to show the solution of the two-dimensional problem with the use of the simplified methods currently used. It is concluded that the values of the forces in the wall can be obtained taking into account the characteristics revealed in the study and using simple schemes. Although these values are approximate, they are considerably closer to reality than those determined within the framework of the two-dimensional problem. It is suggested that model and prototype investigations of typical sections of retaining walls be conducted to establish the effect of their three-dimensional work. (Doria-PTT)
W89-00076

EARTHQUAKE RESPONSE OF SUBMERGED CIRCULAR ARCH,
Houston Univ., TX. Dept. of Civil Engineering.
A. N. Williams, and S. T. Mau.
Journal of Waterway, Port, Coastal, and Ocean Engineering (ASCE) JWPED5, Vol. 114, No. 4, p 405-442, July 1988. 7 fig, 12 ref, 3 append.

Descriptors: *Earthquakes, *Underground structures, Mathematical studies, Arches, Green's function, Seismic waves, Mathematical equations.

A Green's function approach has been utilized to calculate the dynamic response of a long, submerged, cylindrical shell structure subjected to horizontal or vertical ground excitation. The problem was idealized as two-dimensional, and the governing equations were taken to be those of a circular arch. A new Green's function has been presented for the fluid domain and was used in conjunction with a previously derived Green's function for the arch to solve the coupled fluid-structure interaction problem. It was found that if the arch is almost rigid, then the dynamic pressure distribution is affected only by the closeness of the excitation frequency to the natural vibration frequencies of the fluid region alone. In this case, the vertical ground excitation has a more significant effect than the horizontal ground excitation. For a more flexible arch, as examined in the present study, the arch-fluid interaction is significant and results in a large downward shift in each of the natural vibration frequencies of the combined system from those of the dry flexible arch alone. The pressure distribution is significantly affected by the vibrational modes of the arch, and so clearly the designer should consider the effects of fluid-structure interaction. (Lantz-PTT)
W89-00306

OUTLET STRUCTURE DESIGN FOR CONDUITS AND TUNNELS,
Saskatchewan Univ., Saskatoon. Dept. of Civil Engineering.
C. D. Smith.
Journal of Waterway, Port, Coastal, and Ocean Engineering (ASCE) JWPED5, Vol. 114, No. 4, p 503-515, July 1988. 5 fig, 1 tab, 11 ref, 2 append.

Descriptors: *Outlets, *Design standards, *Conduits, *Tunnels, *Hydraulic models, Model studies, Mathematical models, Mathematical equations, Flow velocity, Channel flow.

The analysis and experimental work leading to the development of design criteria for an outlet structure is described. The recommended design consists of a transition and stilling basin with straight diverging sidewalls. The rate of sidewall divergence is expressed as a function of the width ratio and Froude number. Design values were determined from model tests carried out for both round and square conduits. Design criteria were based upon observations on the effective position of the hydraulic grade at the outlet, head losses in the transition, depth and velocity distribution in the transition, stability of the hydraulic jump, downstream velocity distribution and scour tendencies in the discharge channel. A critical feature of the design is the rate of wall flare necessary to produce a stable jump. This was found by determining the coefficient for a modified Rouse equation from observations on 78 different model transitions. The models covered a range of width ratios and Froude numbers. The recommended design was subsequently verified on four specific models. Detailed performance characteristics for one of these models are included. (Lantz-PTT)
W89-00307

RISK ANALYSIS FOR FISH DIVERSION EXPERIMENTS: PUMPED INTAKE SYSTEMS,
Great Salt Bay Experimental Station, Damariscotta, ME.
For primary bibliographic entry see Field 8I.
W89-00318

HYDRODYNAMIC-STIFFNESS MATRIX BASED ON BOUNDARY ELEMENTS FOR TIME-DOMAIN DAM-RESERVOIR-SOIL ANALYSIS,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Inst. of Structural Engineering.
For primary bibliographic entry see Field 8B.
W89-00447

TRANSIENT PRESSURES IN HYDROTECHNICAL TUNNELS DURING EARTHQUAKES,
University of Southern California, Los Angeles.
For primary bibliographic entry see Field 8E.
W89-00448

USE OF CLAY SOILS IN THE CONSTRUCTION OF CUTOFF CURTAINS,
For primary bibliographic entry see Field 8D.
W89-00549

EFFECT OF SEEPAGE ON EARTH DAMS,
For primary bibliographic entry see Field 8D.
W89-00550

EXPERIENCE IN DETERMINING THE NUMERICAL CHARACTERISTICS OF LANDSLIDE MOVEMENTS,
V. N. Vlasenko, G. D. Kuroshev, and V. G. Andreev.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 1, p 21-24, July 1987. 1 fig, 8 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 1, p 28-30, January 1987.

Descriptors: *Construction, *Landslides, *Structural engineering, *Hydroelectric stations, *Engineering geology, Soviet Union, Mountains.

In Soviet practice considerable experience has been gained in constructing antislide structures. Their designing is preceded by obtaining numerical characteristics of the slide, including those that are determined by geodetic methods: boundaries of the surface of the slide, compression and tension zones, rates and directions of movement of individual sections, and position of the slip surface. The method of geodetic works for obtaining numerical characteristics of the dynamics of the slide located in the region of construction of the Miatla hydroelectric station on the Sulak River in Dagestan was examined. The use of the right-angle intersection method at hydrodevelopments in mountain regions makes it possible to obtain the movements of a slide practically in any part of it with small expenditures and sufficient accuracy. For a known direction of displacement the placement of the reference points and point being determined along one line of displacement and determination of the distances from the reference point to those being determined by means of a geodetic-distance meter are effective. (Brock-PTT)
W89-00551

CALCULATION OF CHANNEL DEFORMATIONS OF LARGE EARTH CANALS WITH DAMLESS WATER INTAKE FROM RESERVOIRS,
V. I. Antropovskii.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 1, p 31-36, July 1987. 3 tab, 11 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 1, p 34-37, January 1987.

Descriptors: *Channel morphology, *Reservoirs, *Rivers, *Canals, *Mathematical analysis, Earth canals, Water intake, Damless intake, Scour, Channel erosion.

The characteristics of estimating channel deformations in the head stretches of large earth canals (large length of the stretch and forecast period in advance, limited time of compilation under conditions of multiple stages and multiple variants of design) predetermined the use of simplified balance and morphometric methods. In this case it is possible to perform calculations at once for the final, ultimate state of the channel (without consideration of the course of deformation in time), which considerably simplifies them. The use of the Irtysh River on the stretch of its outflow from Lake Zaisan as an analog of a large earth canal with a damless intake confirms the possibility of determining the order of magnitude of general channel deformations by simplified balance and morphometric methods. The calculations performed can be used under similar geological and hydrological conditions. (Brock-PTT)
W89-00553

EXPERIENCE IN OPERATING HYDRAULIC STRUCTURES AND EQUIPMENT OF HYDROELECTRIC STATIONS,
For primary bibliographic entry see Field 8C.

W89-00554

ESTIMATION OF THE RELIABILITY OF EARTH DAMS WITH CONSIDERATION OF SEISMIC LOADS,
For primary bibliographic entry see Field 8E.
W89-00557

PERFORMANCE OF BURIED SMALL PIPES,
McMaster Univ., Hamilton (Ontario). Dept. of Civil Engineering and Engineering Mechanics.
A. Ghobarah.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 114, No. 3, p 476-489, August 1988. 10 fig, 1 tab, 10 ref.

Descriptors: *Hydraulic equipment, *Pipes, *Plastic pipes, *Materials testing, Conveyance structures, Soil compaction, Compaction, Stress, Pressure distribution, Load distribution.

An analytical and experimental program was conducted to study the deflection and load-carrying capacity of small-diameter corrugated plastic drain pipes. The pipe samples were buried in different soils with various compaction conditions around the pipe. Measurements were taken of the vertical deflection and the pressure around the pipe under a wide range of surface loads. It was found that the most important parameters governing the pipe deformation are the pipe stiffness and the type and degree of compaction of the soil around the pipe. The variation of the modulus of elasticity of the pipe with deformation should be taken into account in pipe deflection prediction. This factor is particularly important in the case of small-diameter pipes buried in loose soil. The pipe stiffness was found to deteriorate under cyclic loading and unloading. The measured lateral pressure distribution was found to be almost uniform, which departed from the simplified parabolic assumption. (Author's abstract)
W89-00754

FUTURE PROSPECTS FOR HYDRO ELECTRICITY AND WINDPOWER,
North of Scotland Hydro-Electric Board, Edinburgh.
For primary bibliographic entry see Field 6C.
W89-00793

POLITICS OF HYDRO-MEGAPROJECTS: DAMMING WITH FAINT PRAISE IN AUSTRALIA, NEW ZEALAND, AND BRITISH COLUMBIA,
Victoria Univ. (British Columbia). Dept. of Geography.
For primary bibliographic entry see Field 6E.
W89-00836

LONDON WATER RING MAIN,
Thames Water Authority, London (England).
For primary bibliographic entry see Field 5F.
W89-00840

PACKAGE WATER TREATMENT FACILITIES FOR REFUGEE COMMUNITIES,
For primary bibliographic entry see Field 5F.
W89-00841

TIDAL POWER RUFFLES FEATHERS,
R. Milne.
New Scientist NWSCAL, Vol. 118, No. 1614, p 38-39, May 1988.

Descriptors: *Construction, *Tidal powerplants, *England, *Hydroelectric power, *Ecological effects, Environmental effects, Estuaries, Capital costs, Severn River, Mersey River.

Not long ago the U. K. Department of Energy was asked to back a plan to build a three-stage tidal power barrage across the Wash, in England. It would have stretched from the Humber to the north Norfolk coast. An initial assessment of the project by the Mersey Barrage Company concluded there are no fundamental technical reasons why the proposal should not be taken a stage further. According to a recent estimate from the government's Energy Technology Support Unit, the technical potential of tidal power could be as much as 50 terrawatt-hr/yr. This is equivalent to just under 20% of present electricity demand. Construction of a barrage will disrupt the feeding patterns of wildfowl and shorebirds. Changes in levels of salinity and silt deposition will also affect the invertebrates. The question of water quality, also concerns the water authorities. They supply consumers with water from the river systems feeding the estuaries. Large quantities of industrial waste and domestic effluent is also discharged into the estuaries. The backers of the tidal power project believe that the environmental problems can be overcome. However, the enormous capital costs of the project may be difficult to obtain. (Author's abstract)
W89-00850

GENERALIZED RECTANGULAR WEIR EQUATIONS,
Roorkee Univ. (India). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W89-00905

DONGJIANG: A 500 MW HYDRO PLANT FOR HUNAN PROVINCE,
China International Engineering Consulting Corp., Changsha (China).
For primary bibliographic entry see Field 8C.
W89-01001

PLANNING AND CONSTRUCTION OF THE PAHALGAM SCHEME,
Tata Consulting Engineers, Bombay (India).
M. V. Brahme, and Y. S. Dandekar.
International Water Power and Dam Construction IWPCDM, Vol. 40, No. 8, p 24-26, August 1988. 6 fig.

Descriptors: *Hydroelectic power, *Pahalgam Hydro Scheme, *Hydroelectric plants, *India, *Project planning, *Hydraulic structures, *Environmental effects, Diversion structures, Penstocks, Case studies, Powerplants, Costs, Siphons, Environmental effects, Kashmir Valley.

The Kashmir valley, in the Indian Himalayas, has many potential sites for hydropower development because of its favorable topography. A small hydropower station, with a capacity of 4.5 MW, is under construction in the valley at Pahalgam. A case study is presented of the planning process for the scheme. Particular care has to be taken to minimize environmental impact, as the site is in a popular resort area. Aspects highlighted in the article include diversion weirs, the 1375 m-long power channel, the inverted siphon, the forebay, three penstocks and powerhouse, and project cost. (Author's abstract)
W89-01004

DEVELOPING RELEASE SCHEDULES FOR A GATED SPILLWAY,
Irrigation Design Organization, Roorkee (India).
N. Singh.
International Water Power and Dam Construction IWPCDM, Vol. 40, No. 8, p 35-37, August 1988. 4 fig.

Descriptors: *Reservoir operations, *Spillway gates, *Spillways, *Flood control, Gates, Hydraulic equipment, Water level, Dams, Reservoirs, Influent water, Flow rates, Water level fluctuations, Engineering, Management planning, Sri Lanka, Kotmale Dam, Hydraulic structures, Hydraulic engineering.

To ensure that a gated spillway can be operated safely and effectively in cases of extreme flows, spillway operation schedules should be drawn up that are based on reservoir data that are immediately available to the operating staff. The procedure will thus not depend on communication systems that could fail, or on expert analysis that might not be available at the time. The development of such an operating schedule at the Kotmale Dam in Sri Lanka is described. Aspects of the operation schedule highlighted in the article include permitted reservoir level for various inflow rates and procedures for the spillway operation, which is based on such information as the rate of rise or fall in the reservoir level, current outflow from gate settings, and current reservoir level. (Author's abstract)
W89-01006

IMPROVEMENT OF THE LAYOUTS AND DESIGN OF UNDERGROUND HYDRAULIC STRUCTURES,
For primary bibliographic entry see Field 8E.
W89-01172

AUTOMATION OF CONVEYOR TRANSPORT AT THE CONSTRUCTION SITE OF EARTH DAMS,
For primary bibliographic entry see Field 8H.
W89-01173

SIZE OF THE CONCRETE PART OF A COMBINED APRON BELOW LOW-HEAD OUTLET WORKS,
For primary bibliographic entry see Field 8B.
W89-01175

EVALUATION OF THE RELIABILITY OF WAVE-PROTECTION SLAB REVETMENTS OF EMBANKMENT SLOPES,
For primary bibliographic entry see Field 8D.
W89-01176

CAPACITY OF ICE-COVERED CANALS,
For primary bibliographic entry see Field 8B.
W89-01177

CHARACTERISTICS OF THE ORGANIZATION AND PERFORMANCE OF WORKS IN THE DAM FOUNDATION OF THE AL-HADITHAH HYDRO DEVELOPMENT (IRAQ),
For primary bibliographic entry see Field 8F.
W89-01182

8B. Hydraulics

IMPROVEMENT OF THE EFFECTIVENESS OF SPILLWAY OPERATION OF HIGH-HEAD HYDROELECTRIC STATIONS,
P. R. Khlopenkov.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 4, p 183-193, October 1987. 3 fig, 4 tab, 11 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 4, p 11-18, April 1987.

Descriptors: *Spillways, *Hydroelectric plants, *Dams, *Hydraulic design, Powerplants, Cavitation, Flow, Hydraulic structures, Jets, Mathematical analysis, Engineering, Hydraulic engineering, Cost analysis.

A method is suggested for reducing the cost of a hydro development by increasing the unit discharges without additional strengthening and deepening of the structures for dissipating the energy of the flow in the lower pool. It is necessary first to separate the flow being discharged into two or three jets directly within the spillway face of the dam, to restructure their flow relative to one another, and to join the components of the flow with the lower pool by mutually different regimes one after the other at a different distance from the dam. Separation of the flow in the exit zone leads to a reduction of energy loss on compression of the air, increase of the distance of deflection of the jet, and substantial reduction of the volume of the vapor-air cloud above the flow being discharged. The method makes it possible to take into account the characteristics of the behavior of a two-phase mixture of the flow and to more reliably estimate the parameters and distance of deflection of the jet. (Doria-PTT)
W89-00067

EFFECT OF RUNOFF VARIABILITY ON DEFORMATION OF ERODIBLE CHANNELS NEAR STRUCTURES,
For primary bibliographic entry see Field 2J.
W89-00072

COMPONENTS OF FORCES OF A RESERVOIR ACTING ON THE FOUNDATION OF HIGH DAMS,
V. V. Tetel'min.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 4, p 224-230, October 1987. 2 fig, 2 tab, 10 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 4, p 40-44, April 1987.

Descriptors: *Reservoirs, *Dams, *Dam foundations, *Dam stability, *Hydraulic engineering, *Stress analysis, Engineering, Seepage, Model studies, Deformation, Rheology.

Observations on the settlement of dams were carried out for evaluating the state of the dam and predicting it in the future, and for developing the maximum allowable indices. Regular waves of an increase-decrease of the seepage head in the stratum of the permeable rock foundation induced by a change in the upper pool level cause elastic compressive-tensile deformations of the blocks composing the rock mass. These are transmitted to the surface and manifested in seasonal vertical translational movements of dams with a considerable amplitude. The waves of increase-decrease of pressure being transmitted by the reservoir into deep horizons of the rock foundations propagate with a velocity that depends on the permeability and elastic properties of the mass. Therefore stabilization of the settlements of dams caused by these waves occurs with a certain, sometimes considerable, lag with respect to stabilization of the upper pool level. The proposed model of deep penetration of a seepage flow into the stratum of rock foundations most completely takes into account the observed dynamics of dam settlements. (Doria-PTT)
W89-00073

ADJUSTING AND MODERNIZATION OF THE SYSTEM CONVERTING UNITS TO SYNCHRONOUS CAPACITOR OPERATION AT THE SAYANO-SHUSHENSKOE HYDROELECTRIC STATION,
For primary bibliographic entry see Field 8C.
W89-00074

BIOCHEMICAL MODELS FOR THE HYPOLIMNETIC OXYGEN DEPLETION IN LAKES IMPACTED BY WASTEWATER DISCHARGES: 1. ALTERNATIVE MODELS,
McMaster Univ., Hamilton (Ontario). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5C.
W89-00186

HYDRODYNAMIC-STIFFNESS MATRIX BASED ON BOUNDARY ELEMENTS FOR TIME-DOMAIN DAM-RESERVOIR-SOIL ANALYSIS,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Inst. of Structural Engineering.
D. H. Wepf, J. P. Wolf, and H. Bachmann.
Earthquake Engineering and Structural Dynamics IJEEBG, Vol. 16, No. 3, p 417-432, April 1988. 17 fig, 12 ref, append.

Descriptors: *Hydrodyanamics, *Dams, *Hydraulic structures, *Dam stability, *Earthquakes, *Mathematical analysis, Stength, Reservoirs, Physical properties, Hydraulic properties, Seismic waves, Boundary conditions, Resistivity.

For a reservoir with an arbitrary shape of the upstream dam face and of the bottom including an adjacent regular part of constant depth extending to infinity, the hydrodynamic-stiffness matrix in the frequency domain for a displacement formulation was derived using the boundary-element method. The fundamental solution takes the boundary condition at the free surface into account. The analytical solution of the semi-infinite reservoir was used to improve the accuracy. To be able to transform the hydrodynamic-stiffness matrix from the frequency to the time domain, the singular part consisting of its asymptotic value of omega approaching infinity is split off. It consists of an imaginary linear term in omega that can be interpreted as a damper with a coefficient per unit area equal to the product of the mass density and the wave velocity. This also applies for a reservoir bottom of arbitrary shape. The remaining regular part of the stiffness matrix is transformed numerically. The corresponding interaction force-displacement relationship involves convolution integrals. This boundary-element solution agreed well with analytical results and with those of other numerical procedures based on a time-stepping method. The method was also applied to an actual earthquake acting on a reservoir with an irregular part with an inclined bottom and a regular part extending to infinity. The results of the analysis in the time domain coincide with those determined in the frequency domain. (Author's abstract)
W89-00447

FLOW REGIMES AND DYNAMIC EQUILIBRIUM OF MORPHOLOGICAL CHANGES AT KOYCEGIZ LAKE INLET, TURKEY,
Middle East Technical Univ., Ankara (Turkey). Coastal and Harbor Engineering Center.
E. Ozhan.
Coastal Engineering COENDE, Vol. 12, No. 2, p 109-132, June 1988. 18 fig, 1 tab, 5 ref, append.

Descriptors: *Channel morphology, *Lake Koycegiz, *Turkey, *Sediment transport, *Flow characteristics, *Inlets, Channel flow, Flow profiles, Seasonal variations, Equilibrium, Lake morphology, Water circulation, Topography.

Koycegiz Lake discharges into the southern Aegean Sea through a waterway of 14 km length. There exist variations in the local sand transport around the inlet during the year so that the cross-sections at the channel and the neighboring sea bed topography show seasonal change exhibiting a dynamic equilibrium behavior. Field measurements were carried out at the inlet for about a year for the purpose of understanding the nature of water motions and the resulting sedimentation patterns. The observed dynamic equilibrium of the inlet's topography is discussed. Among these findings are the fact that two distinct seasons, one wet and one dry, exist for the inlet currents. During the dry season extending from March to October, reversing inlet currents that are caused by the weak tidal motion are seen. In this season, sand brought by small waves as local longshore transport is deposited in gorge sections. Erosion and accretion of the inlet take place as a local phenomenon, in the form of seasonal exchanges of sand between the gorge sections and the offshore area that lies between the barrier beach and Delikada Island. (Author's abstract)
W89-00449

ANALYSIS OF TURBULENT BUOYANT JET IN DENSITY-STRATIFIED WATER,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
For primary bibliographic entry see Field 5B.
W89-00491

ANALYSIS OF THE EFFECTS OF SUSPENDED SEDIMENT OF HUANGHE RIVER ON HARBOR CONSTRUCTION BY USING NOAA IMAGES, (IN CHINESE),
Tianjin Inst. of Water Transport Engineering (China).
For primary bibliographic entry see Field 2J.
W89-00536

CALCULATION OF THE SUSPENDED LOAD IN RIVERS AND CANALS,
For primary bibliographic entry see Field 7B.
W89-00552

CALCULATION OF CHANNEL DEFORMATIONS OF LARGE EARTH CANALS WITH DAMLESS WATER INTAKE FROM RESERVOIRS,
For primary bibliographic entry see Field 8A.
W89-00553

FLOW SIMULATION USING CHANNEL NETWORK MODEL,
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Water Resources and Environment Div.
For primary bibliographic entry see Field 7B.
W89-00751

FLOW CAPACITY OF CULVERTS ON OREGON COAST RANGE FOREST ROADS,
Riverside Technology, Fort Collins, CO.
B. T. Piehl, M. R. Pyles, and R. L. Beschta.
Water Resources Bulletin WARBAQ, Vol. 24, No. 3, p 631-637, June 1988. 6 fig, 2 tab, 11 ref.

Descriptors: *Maximum flow, *Culverts, *Flood discharge, *Oregon, *Design criteria, *Peak flow, *Culvert flow, Stream discharge, Pipes, Roads, Structures, Runoff, Forest hydrology, Mountains.

One hundred twenty-eight stream-crossing culverts in the central Oregon Coast Range were evaluated for peak flow capacity and were compared with current design guidelines. Their ability to pass the 25-year peak flow, as mandated by Oregon State Forest Practice Rules, and their maximum flow capacity were determined. Over 40 percent of the culverts were unable to pass the 25-year peak flow without headwater overtopping the roadfill. Installing the next larger pipe size at an additional original installation cost of about 14 percent would have allowed nearly all these culverts to pass the 25-year peak flow. Culvert capacity varied with ownership and watershed size. (Author's abstract)
W89-00878

EXTREME PRESSURES IN HYDRAULIC-JUMP STILLING BASINS,
QIT-Fer et Titane, Inc., Montreal (Quebec).
J. W. Toso, and C. E. Bowers.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 114, No. 8, p 829-843, August 1988. 8 fig, 1 tab, 28 ref.

Descriptors: *Hydraulic jump, *Stilling basins, *Pressure fluctuations, *Froude number, *Fluid mechanics, *Model studies, Chutes, Spillways, Hydraulic engineerings.

A study was conducted to obtain information on extreme pressures in hydraulic jump, using an open channel model with both surface and chamber mounted pressure transducers. Data are presented for Froude numbers from 3-10, with both developed and undeveloped incident flow, test runs up to 24 hr in length, chute slopes of 0, 15, 30, and 45 degrees, jump locations on the chute as well as at the tow of the chute, and with and without chute blocks, intermediate blocks, and end sills. Peak values of RMS (root-mean-square) dimensionless pressure fluctuations Cp' up to 0.10 and dimensionless pressure fluctuation Cp-values up to 1.3 were obtained. The peak value of Cp depended on location in the jump, chute slope, incident Froude number, incident flow development, and the length of test run. Brief data on areal coverage of pulses are also included. The normal distribution did not conform to extreme pressures. (Author's abstract)
W89-00896

SCOUR CHANNEL DEVELOPMENT AFTER SPILLWAY FAILURE,
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 2J.
W89-00897

FRICTION FACTOR EVALUATION IN GRAVEL-BED RIVERS,
Universita di Reggio Calabria, Cosenza (Italy). Dipt. di Difesa del Suolo.
C. Colosimo, V. A. Copertino, and M. Veltri.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 114, No. 8, p 861-876, August 1988.

11 fig, 2 tab, 36 ref, 2 append.

Descriptors: *Alluvial channels, *Friction, *Flow friction, *Flow resistance, *River flow, Estimating equations, Statistical methods, Field tests, Froude number, Sediment transport, Mathematical equations, Italy.

Field data gathered from 43 river reaches of Calabria (southern Italy) were employed to develop a theoretically based equation for predicting the f-friction factor that takes into account both the Froude number and the sediment mobility parameter. The river reaches investigated had: (1) Reasonably uniform and relatively low flow; (2) no appreciable vegetation in the channel bed and banks; (3) a fully developed turbulent flow; (4) a friction slope greater than 0.2%; (5) small and intermediate scale roughness; (6) a mobility parameter greater than the critical value in more than 50% of the cases; and (7) a Froude number between 0.20-1.30. Statistical techniques were used to derive an equation for estimating f that takes into account the physical processes controlling flow resistance beyond the range of the collected data. The equation also fits within + or - 10% the Calabrian field data. (Author's abstract)
W89-00898

SUSPENSION OF LARGE CONCENTRATIONS OF SANDS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W89-00900

HORIZONTAL ROUND BUOYANT JET IN SHALLOW WATER,
California Univ., Berkeley. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5E.
W89-00902

PLUNGING AND STREAMING FLOWS IN POOL AND WEIR FISHWAYS,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W89-00904

GENERALIZED RECTANGULAR WEIR EQUATIONS,
Roorkee Univ. (India). Dept. of Civil Engineering.
P. K. Swamee.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 114, No. 8, p 945-949, August 1988. 2 fig, 6 ref, append.

Descriptors: *Weirs, *Flow characteristics, *Flow pattern, *Mathematical equations, Mathematical models, Hydraulic models.

Weirs are probably the oldest hydraulic structure made by man for stream flow diversion and flow measurements. A weir having a thin edge as the width is termed a sharp-crested weir. As the crest width is varied, there are three distinct trends representing long-crested, broad-crested, and narrow-crested weirs. A generalized weir equation valid for sharp-crested, narrow-crested, broad-crested, and long-crested weirs is proposed. The equation holds good for extreme variations of head/weir height ratio and head/weir width ratio. (VerNooy-PTT)
W89-00905

ALLUVIAL CHANNEL HYDRAULICS,
For primary bibliographic entry see Field 2J.
W89-01017

SIZE OF THE CONCRETE PART OF A COMBINED APRON BELOW LOW-HEAD OUTLET WORKS,
A. E. Andreev, and V. V. Nemchinov.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 9, p 524-530, September 1988. 2 fig, 9 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 9, p 25-28, September 1987.

Descriptors: *Flow, *Critical flow, *Hydraulic structures, *Hydraulic jump, *Revetments, Concrete construction, Standing waves, Outlets, Standing waves.

Hydrotechnical construction projects sometimes cause an undular jump associated with the region of near-critical flows within the outlet conduit of low-head structures. An attempt is made to obtain a method of calculating the revetment of the lower pool taking into account the characteristics of the structure of near-critical flows forming under three-dimensional transition conditions. Calculation of the lower pool revetment can be reduced to a determination of the length of the concrete platform (Lre) limited to the size of the first solitary wave and of the edge height (alpha) corresponding to the condition of free spreading of the flow on the channel stretch beyond the ledge. Calculation of Lre and alpha are presented along with an calculation example limited to the determination of the length of the concrete platform for a given ledge height. (Miller-PTT)
W89-01175

CAPACITY OF ICE-COVERED CANALS,
E. G. Gladkov, and G. S. Altunina.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 9, p 539-542, September 1988. 4 tab, 7 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 9, p 33-36, September 1987.

Descriptors: *Ice covers, *Discharge capacity, *Flow velocity, *Canals, Rivers, Statistical analysis, Hydraulic engineering, Soviet Union, Cold regions, Cold regions, Field tests.

A method for determining the capacity of ice-covered canals was developed using on-site observations on a number of streams. The data were collected in an amount necessary for statistical processing and analysis. To determine the hydraulic parameters, the data of 135 winter discharges were measured on the Irtysh-Karaganda and Northern Donets-Donbas canals and Tom', Desna, Svir', Sukhona, and other rivers by a two layer scheme. A statistical analysis of the results showed that the average ratio of the velocities of the ice-covered compartment to the bottom compartment is 1.04. This was the first time that a method determining the capacity of ice-covered canals was developed on such extensive data of on-site observations on operating canals and subjected to such extensive verification. (Miller-PTT)
W89-01177

USE OF HYDROGEOCHEMICAL SAMPLING DATA IN HYDRAULIC ENGINEERING,
For primary bibliographic entry see Field 2F.
W89-01178

8C. Hydraulic Machinery

CONTROL OF THE CONDITIONS FOR INPUT OF HYDROPOWER INTO THE UNIFIED POWER SYSTEM OF THE U.S.S.R.,
A. S. Reznikovskii, and M. I. Rubinshtein.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 7, p 387-394, January 1988. 4 fig, 2 tab, 2 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 7, p 7-12, July 1987.

Descriptors: *Hydroelectric power, *Hydroelectric plants, *Transmission lines, *Transmission towers, *Soviet Union, Reservoirs, Hydraulic structures, Electric power plants, Reservoir management.

The main directions of the economic and social development of the USSR in 1986-90 and in the period up to the year 2000 call for development of DC and AC transmission lines between systems and continuation of the formulation of the unified power system of the country. Strengthening of the bonds between power systems requires an investigation of th optimal regimes of the combined operation of reservoirs of cascades of large hydroelectric stations under the new conditions of their operation. Such an investigation will make it possible to introduce refinements into the indices of the hydrostations, which will be taken into account during further planning of the development of the system up to the year 2000 and into the 21 Century. The results of the preliminary studies of this problem are presented. The main regulators of hydropower in the system will be the Angara-Enisei cascade and the Turukhan hydrostation. The Turukhan station will play the principal role in stabilizing the input of hydropower into the system, and will provide its annual distribution in the interests of the power industry while satisfying the requirements of nonpower water consumers. Realization of the combined operation in a regime of compensated regulation of the Volga-Kama and Angara-Enisei cascades and Turukhan hydrostation makes it possible to achieve, in the winter, constancy of production of the hydrostations, making the system independent of variability of river runoff. (Friedmann-PTT)
W89-00034

INTRODUCTION OF NEW TECHNOLOGY ON THE CONSTRUCTION OF THE SHAMKHOR HYDROELECTRIC STATION,
For primary bibliographic entry see Field 8A.
W89-00039

USE OF HORIZONTAL DRAINAGE FOR DRAINING DAM SLOPES,
K. Faiziev.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 7, p 417-421, January 1988. 3 fig, 1 tab, 16 ref.Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 7, p 28-31, July 1987.

Descriptors: *Earth dams, *Construction, *Soviet Union, *Design criteria, Hydrodynamics, Pumped storage, Hydraulic design.

The experience in the design and construction of hydro developments of various purposes, especially recently, shows that a tendency toward the primary construction of earth dams dominates in Soviet dam construction. In this case, poorly permeable earth materials are being used rather widely, not only in the watertight elements (cores and facings), but also in the body of the dam shoulders. To reduce the hydrodynamic forces in the dam body occurring under the indicated circumstances, and to increase the stability of the slopes of such dams, horizontal drains arranged in tiers are widely used. This method was also used widely in the design and construction of a number of dams abroad. Therefore, it is of interest to study the indicated experience in draining dams. The experience of using the drainage method showed that it is especially effective for dams of reservoirs, mudflow storages, and for dikes of pumped-storage stations, where regular rapid emptying and filling of the upper pool occurs. (Friedmann-PTT)
W89-00040

NEW LIFE FOR SMALL HYDROELECTRIC STATIONS IN KIRGIZIA,
Y. P. Belyakov, A. G. Zyryanov, and M. S. Sulaimanov.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 7, p 425-428, January 1988. 1 tab, 6 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 7, p 34-36, July 1987.

Descriptors: *Hydroelectric power, *Resources development, *Hydroelelectric plants, *Soviet Union, *Economic aspects, Electric power, Exploitation.

Problems related to the development of small hydrostations in the Soviet Union are discussed. The main task in developing small hydrostations in Kirgizia, for example, is the compilation of a scheme of using the hydropower resources of small rivers and determination of their economic potential. Kirgizia has enormous supplies of hydropower resources, of which about 20% is presently being used. Small rivers, irrigation reservoirs, and canals are not being used for electric power production.

The total hydropotential of small rivers is 72 billion kWh, of which 42.7 billion kWh can be technically used. The presently operating small hydrostations of the Alameda cascade are cost-effective and can serve as a model for future hydrostations. The development and creation of experimental models of microhydrostations are a substantial contribution to small hydro development and savings of fuel resources. (Friedmann-PTT)
W89-00042

OPTIMIZATION OF THE MUD INTAKES OF DREDGES WITH SUBMERSIBLE PUMPS,
S. P. Ogorodnikov, I. I. Mikheev, and A. E. Kulakov.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 7, p 432-436, January 1988. 4 fig, 4 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 7, p 39-42, July 1987.

Descriptors: *Pumps, *Dredging, *Hydraulic machinery, Mud, Hydraulics, Testing procedures, Excavation, Optimization.

A direction has been outlined for improving dredges related to the use of submersible dredging pumps. When a dredging pump is submerged below the water level, its sucking capacity increases by the amount of the water column above the axis of the pump, which provides the possibility both of increasing the consistency of the being sucked in and the depth of the face being excavated. Tests were carried out according to a special program for determining the optimal parameters of the process of intake of the dredge with a submersible pump and checking the effectiveness of it sue at various depths of excavating the face. Tests of an intake with a submersible pump showed that the use of submersible pumps provides a substantial increase of the output of dredges. Under the particular test conditions, this increase of output was from 60 to 66%. The tests confirm the usefulness of submersible pumps not only when excavating soils at great depths (more than 10 m), but also at small depths (less than 10 m). It follows from this that submersible pumps should be recommended for use not only when working in deep burrow pits, but also when performing ordinary hydraulic works and on ordinary dredges by modernizing them. (Friedmann-PTT)
W89-00044

50TH ANNIVERSARY OF THE MOSCOW CANAL,
For primary bibliographic entry see Field 8A.
W89-00049

RELIABILITY AND SAFETY INSPECTION OF HYDRAULIC STRUCTURES OF THE MOSCOW CANAL,
For primary bibliographic entry see Field 8A.
W89-00051

IMPROVEMENT OF THE ELECTRICAL EQUIPMENT AND CONTROL SYSTEMS TO THE LOCK MECHANISMS OF THE MOSCOW CANAL,
L. I. Medvedev.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 6, p 331-336, December 1987. 4 fig. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 6, p 17-20, June 1987.

Descriptors: *Canals, *Moscow Canal, *Navigation canals, *Electrical equipment, *Automation, *Gates, *Locks, Hydraulic design, Maintenance, Soviet Union.

During 50 years of operation the 11 locks of the Moscow Canal have carried out more than 1,600,000 lockages and passed more than 5,130,000 ships. The first years of operation of the equipment showed that the adopted schemes of the drives were mainly successful and provided normal operation of the mechanisms. However, later, considerable work was done by the operators in collaboration with a number of design and research institutes and the dynamo plant in the area of investigation and further improvement of the electric drive of the gate mechanisms. In the search for a new scheme of the drive, in 1953 tests were carried out which made it possible to operate the mechanism at high and low speeds by one group of 45-kW working and synchronizing motors. In 1974 a system of start-regulating contactless devices and synchronous motors with a phase rotor was used on a lock as the drive of the gate mechanisms of the upper head. During operation of the locks there occurs a constant improvement of their control schemes. Various changes aimed at improving the quality and increasing the reliability of their operation are introduced into the existing schemes. (VerNooy-PTT)
W89-00052

POWER FACILITIES OF THE MOSCOW CANAL,
V. S. Zhdanow, and B. S. Uspenskii.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 6, p 336-340, December 1987. 1 fig. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 6, p 25-27, June 1987.

Descriptors: *Hydroelectric plants, *Electrical equipment, *Automation, *Remote sensing, *Moscow Canal, Electric power rates, Water level fluctuations, History, Soviet Union.

The machine variant of the Moscow Canal imposed high requirements on the power facilities both with respect to equipment operating regimes and centralization of control of the water-management complex. The power facilities had to perform the following functions; conduct the normal operating regimes of the hydropower complex with respect to pumping water by the pumping stations and generation of electricity in the hydroelectric stations; maintain the prescribed levels in all pools of the canal; conduct operations of all power structures, providing continuous and economic operation of all equipment of the stations and substations; and conduct reliable supply to all structures of the canal and consumers of adjacent regions with electricity. Over the 50 years of canal operation, three phases of development of controlling the power structures' equipment of the canal can be distinguished. The first was ordinary manual control, and second was automatic control of the equipment, operated under the general supervision of the duty personnel. Lastly, equipment was controlled automatically by special automatic operators changing the load of the units in accordance with the flow of the river, or from the power dispatching point by remote means. In this case the duty personnel of the station do not participate in controlling the equipment. The remote-control system enables the dispatcher to measure quantities (loads of the lines and generator, pool levels, etc.) needed for operation by remote-measurement (RM) means and to obtain signals on the position and state of the equipment by remote-signaling (RS) means. (VerNooy-PTT)
W89-00053

HYDROPOWER EQUIPMENT OF THE MOSCOW CANAL,
I. T. Chibisov.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 6, p 341-344, December 1987. 3 fig. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 6, p 27-30, June 1987.

Descriptors: *Hydroelectric plants, *Electrical equipment, *Pumping plants, *Moscow Canal, History, Soviet Union.

The power structures of the Moscow Canal are pumping stations and hydroelectric stations. The Pumping stations, as five sequentially arranged steps, pump water from the Ivankovo reservoir (elevation 119-124 m) to the water-divide pool (el. 162 m). The VP-250 pumps have been operating at the plants for 50 years without a single breakdown. In the last few years, however, plans have been made for the reconstruction and modernization of the pumping stations to increase the delivery of water along the canal due to the increased water requirements of Moscow. The most powerful hydrostations are the Ivankovo and Skhodnya, each with a capacity of 30,000 kW. These plants are described. During operation, the equipment of both hydrostations was subjected to radical changes in the turbines. Design works for most of the power structures were performed directly at the construction administration. This fundamental relationship between the construction and design departments created favorable conditions for building inspection, coordination, and prompt on-site solutions of technical problems. (VerNooy-PTT)
W89-00054

HYDRAULIC TESTS FOR RECONSTRUCTING THE PUMPING STATIONS ON THE MOSCOW CANAL,
N. P. Bestuzheva.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 6, p 345-349, December 1987. 3 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 6, p 30-32, June 1987.

Descriptors: *Pumping plants, *Hydraulic engineering, *Canals, *Water level, *Moscow Canal, Hydraulic equipment, Pumps, Soviet Union.

The plan for reconstructing the Moscow Canal calls for using it for delivering an additional volume of water from the Upper Volga to Moscow. As long ago as 1979, units with an increased water delivery to 34 cu m/sec were installed in the fifth blocks of the pumping stations of the canal, which prior to this had been reserved. Now it is planned to replace the old existing pumps with a delivery of 25 cu m/sec, by the 34 cu m/sec units on all four lines of the north slope of the canal thus bringing the capacity of the pumping stations to 170 cu m/sec. For developing the plan of replacing the pump units and its hydraulic substantiation, one of the main problems is that of the maximum water level decrease at the intakes of the pumping stations. Solutions are discussed. After reconstructing the pumping stations of the canal and installing the new pumps at lower elevations, the position of minimum water levels in the canal will be limited in the summer only by navigational conditions. Problems also arise when determining the design maximum water levels in pools of the Moscow Canal. Groups of designers and investigators are searching for optimal solutions to problems of the Moscow Canal reconstruction project. (VerNooy-PTT)
W89-00055

SMALL HYDROELECTRIC STATIONS AND PROSPECTS OF THEIR DEVELOPMENT,
A. M. Panasyuk, K. A. Tokombaev, and G. I. Shainova.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 6, p 366-373, December 1987. 5 fig, 2 tab. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 6, p 44-49, June 1987.

Descriptors: *Hydroelectric plants, *Electric power demand, *Water resources development, *Hydraulic design, Hydroelectric power, Design criteria, Soviet Union, Alpine regions.

The use of local energy resources is an alternative to centralized electrical supply of mountain regions of the Soviet Union. Autonomous supply sources in remote regions are needed for small scattered objects such as hydraulic structures of canals, weather stations, and pumping plants, and the economic and domestic needs of range ranching. For objects with power consumption of up to 30-50 kW that are territorially scattered or difficult to access, the use of microhydroelectric stations (micro-HESs) is the most promising solution. For example, for supplying electricity to regions of Kirgizia located beyond the limits of the power system with an area of 400,000-500,000 ha, more than 30,000 tons of liquid fuel per year are required to provide a total power of more than 150,000 kW. The hydropower resources of about 900 small streams with a total annual runoff of 51 billion cu m can be used to irrigate 400,000-600,000 ha of farmlands, which will enable the republic to increase the total sheep stock. It is necessary to widely introduce micro-HESs by the serial manufacture of hydropower blocks with a capacity of 10-30 kW, having generalized the experience of

their design and having created an album of standard designs of micro-HESs. It is expedient to create a specialized organization for the installation, adjustment, and servicing of micro-HESs. In the future it is planned to introduce about 10,000 micro-HESs with a capacity from 1 to 30 kW in the USSR. (VerNooy-PTT)
W89-00059

SET OF DOCUMENTS FOR OVERHAULING RO400-960-11 TURBINES OF THE INGURI HYDROELECTRIC STATION,
V. S. Medvedev.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 6, p 374-377, December 1987. 2 fig. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 6, p 53-55, June 1987.

Descriptors: *Maintenance, *Hydroelectric plants, *Documentation, *Turbines, *Hydraulic turbines, Regulations, Soviet Union, Operation policies.

In conformity with the rules of technical operation of electric stations and networks in the Soviet Union, before overhauling equipment the necessary maintenance documentations for conducting it should be prepared. A set of documents for overhauling the RO400/960-11 turbines and mechanical part of the SV712/227-249 generator has been introduced on the cascade of the Inguri hydroelectric stations. A number of documents were developed in conformity with the requirements of several State Standards. These include: a list of documents, route chart of overhaul, operational charts, measurement charts (service logs), technological instructions, list of spare parts, list of materials, list of equipment, chart of sketches, graph of the technological process, schematic diagram of slinging the assembly units and parts, plan of arrangement, catalog of wearing parts, and labor safety and industrial sanitation instructions. The indicated set of documents calls for complete dismantling of the turbine and mechanical part of the generator. The set of documents provides an improvement in the planning preparation and the overhauling of the turbines, the creation of labor and material standards, an improvement of the quality of repair works, and an increase of the reliability of operation of the overhauled units. (VerNooy-PTT)
W89-00060

IMPROVEMENT OF THE EFFECTIVENESS OF SPILLWAY OPERATION OF HIGH-HEAD HYDROELECTRIC STATIONS,
For primary bibliographic entry see Field 8B.
W89-00067

ADJUSTING AND MODERNIZATION OF THE SYSTEM CONVERTING UNITS TO SYNCHRONOUS CAPACITOR OPERATION AT THE SAYANO-SHUSHENSKOE HYDROELECTRIC STATION,
V. N. Markin, and V. I. Gorodnyanskii.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 4, p 231-236, October 1987. 6 fig. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 4, p 44-48, April 1987.

Descriptors: *Hydroelectric plants, *Hydraulic structures, *Hydraulic equipment, *Automation, Powerplants, Hydraulic design, Soviet Union, Turbines, System conversion, Design criteria, Sayano-Shushenkoe Hydroelectric Station.

The modernized design scheme for automatic control of water expulsion from the runner pit at the Sayano-Shushenskoe hydroelectric station (Soviet Union) is described. Results of tests show that the system is operative and provides reliable control of expulsion and checking of the water level when converting the units to synchronous capacitor (SC) operations. The capacity of the compressed-air tanks is selected with a twofold margin. The three tanks installed using the design pressure of 6.3 MPa could provide successive conversion to SC operation of at least six units. Freeing of the runner from water occurs rapid, (5-15 sec) because of pressure the high pressure in the system, correctly selected diameters of the air delivery lines, presence of a circular groove in the unloading cavity of the runner, and speed of the plug valve. Expulsion of water from the runner pit by the nominal pressure 6.3 MPa during operation of the plug cock according to the design scheme (without an increased time of opening) should be eliminated, since the pressure under the turbine cover at the time of opening the plug cock exceeds the value used in the strength calculation of the cover. The maximum operating pressure in the expulsion system in this case should not exceed 4.5 MPa. (Doria-PTT)
W89-00074

RECONSTRUCTION OF THE SURGE TANK OF THE SENGILEI HYDROELECTRIC STATION,
N. N. Arshenevskii, V. V. Berlin, O. A. Murav'ev, I. L. Krasnik, and I. F. Necheska.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 1, p 1-5, July 1987. 7 fig, 4 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 1, p 14-17, January 1987.

Descriptors: *Hydroelectric plants, *Surge tanks, *Construction, *Hydraulic engineering, Reconstruction, Soviet Union.

In the Soviet Union there are more than 30 hydroelectric stations with surge tanks. The majority of them were put into operation in the postwar years. The development of the theory and practice of calculating transient processes at that time made it possible to determine the characteristics of fluctuations in the tanks only with the introduction of a number of simplifications concerning the change in the discharge through the turbines, elasticity of the water and conduits, and hydraulic resistances. All this led to an overestimation of the amplitude of fluctuations of the tank level and to additional margins of safety. The use of modern methods of calculating transients makes it possible to reveal the indicated margins. They subsequently can be used for increasing the installed capacity of the hydrostations as well as for reconstructing the tanks themselves. Such reconstruction was performed on the Sengelei hydrostation. Modernization of the surge tank of the Sengilei hydrostation confirmed the possibility, in principle, of converting from the design of the differential type with an inside standpipe to a more simple design with additional resistance in the form of a ring diaphragm, which made it possible to reduce severalfold the cost and the time of reconstruction work. (Brock-PTT)
W89-00546

CALCULATION OF PRESSURE TUNNEL LININGS WITH CONSIDERATION OF CONSOLIDATION GROUTING OF THE ROCKS,
N. N. Fotieva, and A. S. Sammal.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 1, p 6-8, July 1987. 4 fig, 4 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 1, p 17-19, January 1987.

Descriptors: *Tunnel linings, *Construction, *Hydraulic engineering, *Engineering geology, *Rock mechanics, Structural engineering, Concrete technology, Mathematical analysis, Grouting.

A method was developed at the Tula Polytechnic Institute for calculating closed in-situ concrete and reinforced-concrete linings of noncircular pressure tunnels with consideration of the presence of a layer of rocks consolidated by grouting. The method is based on solving the 2-dimensional contact problem for a 2-layer ring of arbitrary form (with one axis of symmetry) supporting a hole in a linearly deformable medium and loaded on the inside contour by a uniformly distributed pressure. The calculation scheme is presented. (Brock-PTT)
W89-00547

DETERMINATION OF THE MECHANICAL CHARACTERISTICS OF ROCKS BY THE METHOD OF VOLUME CONFINEMENT OF DEFORMATIONS,
For primary bibliographic entry see Field 8E.
W89-00548

EXPERIENCE IN OPERATING HYDRAULIC STRUCTURES AND EQUIPMENT OF HYDROELECTRIC STATIONS,
V. M. Boyarskii, B. A. Rastoskuev, V. A. Ulyashinskii, B. G. Kartelev, and L. M. Garkun.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 1, p 37-41, July 1987. 4 fig, 5 tab, 1 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 1, p 39-42, January 1987.

Descriptors: *Hydroelectric plants, *Dams, *Spillways, *Overflow channels, Hydraulic engineering.

The structural and functional properties of the overflow dam of the Krasnoyarsk hydroelectric station were examined. Concreting of the spillway face began in 1966 and ended in 1972. The face is in satisfactory condition. The provision of a good quality or ordinary hydrotechnical concrete placed in an absorbing framework creates a sufficiently reliable counteraction to cavitation erosion for dam spillways with a height up to 100 m. A spillway face of relatively cavitation-resistant concrete should be protected in the zone of maximum flow velocities with weather resistant protective coatings, e.g., high-elasticity epoxy. All cases of cavitation damage were characterized by a local source of flow disturbance, e.g., emergence of various steel elements or mechanical damage. (Brock-PTT)
W89-00554

MODIFICATION OF TURBINE RUNNER BLADES AT THE CHIRKEY HYDROELECTRIC STATION,
Z. L. Zelenevskii, and A. A. Kuprik.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 1, p 42-45, July 1987. 2 fig, 3 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 1, p 42-45, January 1987.

Descriptors: *Turbines, *Construction, *Hydroelectric stations, *Hydraulic engineering, Modernization, Reconstruction, Turbine runner blades, Soviet Union.

Existing hydroelectric plants in the Soviet Union are scheduled for modernization and reconstruction. A number of powerplants are to be inspected with an evaluation of the effectiveness of measures on modernization. References are made first of all to hydrostations with obsolete and worn-out equipment. At the same time, considerable reserves for increasing the power parameters of units exist at hydrostations put into operation comparatively recently. The effect of runner modernization on the basis of full-scale tests of the turbines at the Chirkey hydrostation, which underwent modification of the blades by trimming, consisted of (1) a 10% increase of capacity of the hydroelectric powerplant, (2) an increase of efficiency due to a shift of the operating characteristics by 0.5 to 4% toward larger powers for loads of the unit of 50% of the normal and higher; and (3) and increase of efficiency due to an increase of its maximum values at the extremes of the operating characteristics by 0.5 to 3%. Modification of the runner blades of mixed-flow turbines by trimming leads to an increase of the power parameters (power and efficiency) of the turbines, which makes it possible to regrade the units to a higher capacity. The effect of increasing the efficiency increases with an increase of the operating heads of the turbines. (Brock-PTT)
W89-00555

NEW PUMPED-STORAGE STATION DESIGNS,
V. K. Gol'tsman, and S. V. Bortkevich.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 1, p 46-50, July 1987. 2 fig, 4 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 1, p 45-48, January 1987.

Descriptors: *Construction, *Hydraulic engineering, *Pumped storage, Structural engineering, Soviet Union.

The difficulties and conditions involved in constructing a pumped-storage station (PSS) in the European sector of the USSR are discussed. Site

selection presents considerable problems becaue areas suitable with respect to topographic conditions are compared mainly of sands and clays with low physical and mechanical indices. One of the main problems in the design and construction of a PSS is the provision of stability of high natural slopes and pit slopes, especially in the vicinity of the powerhouse. To eliminate possible errors, it is necessary to incorporate considerable safety features in the earthworks. Construction practices applied to the Dnestr PSS, which include an underground powerhouse and shaft layouts with underground delivery and discharge of water, are cited as promising solutions to the problems of PSS construction. (Brock-PTT)
W89-00556

MOBILE FLUME FOR CIRCULAR CHANNEL,
Ecole Polytechnique Federale de Lausanne (Switzerland). Dept. de Genie Civil.
For primary bibliographic entry see Field 7B.
W89-00757

POLITICS OF HYDRO-MEGAPROJECTS: DAMMING WITH FAINT PRAISE IN AUSTRALIA, NEW ZEALAND, AND BRITISH COLUMBIA,
Victoria Univ. (British Columbia). Dept. of Geography.
For primary bibliographic entry see Field 6E.
W89-00836

TIDAL POWER RUFFLES FEATHERS,
For primary bibliographic entry see Field 8A.
W89-00850

HYDROPOWER DEVELOPMENT ON RIVERS IN SCOTLAND,
North of Scotland Hydro-Electric Board, Edinburgh.
F. G. Johnson.
Regulated Rivers Research and Management RRRMEP, Vol. 2, No. 3, p 277-292, July-August 1988. 10 fig, 1 tab, 4 ref.

Descriptors: *Hydroelectric plants, *Regulated rivers, *Scotland, *Reservoir storage, *Environmental effects, *Fish passages, Wales, Pumped storage, Dams, Economic aspects, Politcal aspects.

The development of Britain's limited hydropower resources, most of which is concentrated in Scotland producing on average some 4000 GWh per year (1 GWh is equivalent to one million units or kilowatt hours), is reviewed. The Scottish schemes are dominated by the reservoir storage type although pumped storage plants have been constructed since the 1960s. These latter also occur at two sites in Wales. The performance of existing schemes is examined, with particular reference to environmental aspects, and the potential and prospects for future hydropower development are considered. (Author's abstract)
W89-00952

DONGJIANG: A 500 MW HYDRO PLANT FOR HUNAN PROVINCE,
China International Engineering Consulting Corp., Changsha (China).
T. Jingyi.
International Water Power and Dam Construction IWPCDM, Vol. 40, No. 8, p 11-13, August 1988. 2 fig.

Descriptors: *Yangtze River, *Dams, *Hydroelectric plants, *China, *Design criteria, *Construction, Construction materials, Concrete, Arch dams, Electric powerplants, Electric power, Leishui River, Grouting.

The principal scheme in a major cascade development on the Leishui River in China, a tributary of the Yangtze, is described. The Dongjiang project, now nearing completion, is one of the thirteen plants in the development, which will have an eventual total capacity of 977 MW. Dongjiang incorporates a 157 m-high double-curvature arch dam, currently the highest of its type in China. Aspects of particular interest include concrete temperature control at the site, where summer temperatures reach 28 C, the compaction of the concrete by tractor-mounted vibrators, and an unusual method of joint grouting. (Author's abstract)
W89-01001

INTENSIVE HYDRO DEVELOPMENT OF THE HONGSHUI RIVER,
Ministry of Water Resources and Electric Power, Beijing (China).
C. Xuemin.
International Water Power and Dam Construction IWPCDM, Vol. 40, No. 8, p 16-19, August 1988. 2 fig, 1 tab.

Descriptors: *Hongshi River, *Hydroelectric plants, *China, *Dams, *Design criteria, Construction, Construction materials, Concrete, Gravity dams, Electric powerplants, Hydroelectric power, Project planning, Spillways, Hydraulic design, Water resources development.

With two projects in operation, two projects under construction and two further ones being promoted actively, the Hongshui River is probably the most intensively exploited river in China at present. The hydro capacity in operation and under construction totals 2540 MW. The main elements of the Honghshui river cascade scheme are described here. The operational projects include the Etan and the Dahua; those under construction are the Yantan, with retaining gravity structures at both abutments, a spillway dam in the middle, a powerhouse on the right bank and a lock on the left bank, and the Tianshengquiao low dam project; future projects include the Tianshengquiao high dam project, the Longtan project and the Lubuge tributary project. (Author's abstract)
W89-01002

SIMPLIFIED TURBINE RUNNER SHOWS GOOD CAVITATION RESISTANCE,
Central Water and Power Research Station, Poona (India).
G. J. Rao, R. Prasad, and S. Kulkani.
International Water Power and Dam Construction IWPCDM, Vol. 40, No. 8, p 20-22, August 1988. 3 fig, 4 tab, 4 ref.

Descriptors: *Cavitation, *Hydraulic equipment, *Turbines, *Hydroelectric plants, Economic aspects, Design criteria, Hydraulic engineering, Hydraulic design, Developing countries.

A simplified runner profile for a low head axial flow micro hydro turbine, which could be more economical than conventional runners with aerofoil-shaped blades, has been developed and tested recently in India. The simplicity of design means that the units could be manufactured in small workshops making them particularly suitable for applications in developing countries. This article focuses on investigations carried out at the Pune Research Station on the new runner's resistance to cavitation erosion. Results show that the critical cavitation value for this unconventional runner, compares favorably with that for a conventional Kaplan runner. Its cavitation performance improves at higher discharges as a result of a decrease in the angle of attack at larger guidevane openings by changing the blade angles. It is thus possible to improve the cavitation performance and increase the maximum efficiency of these runners at the same time. Improved cavitation performance of the runner can be achieved by increasing the hub-to-tip ratio. (Author's abstract)
W89-01003

PLANNING AND CONSTRUCTION OF THE PAHALGAM SCHEME,
Tata Consulting Engineers, Bombay (India).
For primary bibliographic entry see Field 8A.
W89-01004

COMPLEX GEOLOGY LEADS TO AN UNUSUAL DESIGN FOR THE LAKHWAR DAM,
Irrigation Design Organization, Roorkee (India).
For primary bibliographic entry see Field 8E.
W89-01005

CHINA'S EXPERIENCE WITH UNDERGROUND WORKS,
Ministry of Water Conservancy and Power, Beijing (China). Water Resources and Hydropower Planning and Design Inst.
For primary bibliographic entry see Field 8H.
W89-01007

VALVES FOR CONTROLLING PRESSURE, FLOW AND LEVEL,
Watts Regulator Co., North Andover, MA.
For primary bibliographic entry see Field 5F.
W89-01102

INCREASE OF THE RELIABILITY AND CONVENIENCE OF OPERATION OF THE GROUP ACTIVE POWER REGULATION SYSTEM OF A HYDROELECTRIC STATION,
M. Y. Rudenskii.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 9, p 548-551, September 1988. 1 fig, 7 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 9, p 39-42, September 1987.

Descriptors: *Reliability, *Hydroelectric plants, *Powerplants, *Hydraulic machinery, Inspection, Testing procedures, Group active power regulation, Soviet Union, Technology.

The problem of supplying a more complete check and protection of the group active power regulation system of a hydroelectric station is examined. The Industrial Association for Organization and Improvement of the Technology and Operation of Electric Stations and Networks (Soyuztekhenergo) developed an improved central regulator based on a two-regulator scheme. The system consists of two identical power regulators - working (main) and reserve (backup) which are united by a common functional check and technological scheme. Such a scheme makes it possible to accomplish mutual automatic check of their operation and protection and prompt testing of the system and to provide constant readiness of the components of the reserve without conducting preliminary inspection and testing. To increase the reliability and convenience of operation, it is expedi-ent to periodically modernize the components of the group active power regulation apparatus during mass production at Soyuzenergoavtomatika. (Miller-PTT)
W89-01179

SOME RESULTS OF INVESTIGATING THE STATE OF THE POWERHOUSE OF THE PLYAVINYAS HYDROELECTRIC STATION,
For primary bibliographic entry see Field 8D.
W89-01180

ULTRASONIC FLOWMETER FOR TESTING UNITS OF LARGE HYDROELECTRIC AND PUMPED-STORAGE STATIONS,
D. B. Radkevich, A. P. Severov, and V. V. Vraitsev.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 9, p 559-563, September 1988. 3 fig, 2 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 9, p 47-49, September 1987.

Descriptors: *Hydroelectric plants, *Flow measurement, *Pumped storage, *Statistical methods, *Discharge measurements, *Ultrasonics, *USSR, Computers, Ultrasonic pulse-time method, Errors, Performance evaluation.

The ultrasonic pulse-time method of fluid discharge measurement is proposed as the most effective way to determine the operating efficiency and main operating characteristics of turbine-generator units of hydroelectric and pumped-storage stations. The ultrasonic pulse-time method of measuring fluid flow is based in measuring the time intervals of the passage of an ultrasonic signal in two directions along an acoustic beam intersecting the flow at a certain angle to its longitudinal axis. Realiza-

tion of this method requires the creation of a complex measuring system with a built-in control computer providing measurement of the time intervals with a nanosecond accuracy as well as the statistical processing of the measurement results during the experiment. The research department of the All-Union Planning, Surveying, and Scientific-Research Institute (Gidroproekt) developed and manufactured the software and hardware of an automated ultrasonic measuring system, including acoustic transducers, analog and digital subsystems, and control computer of the system. A method to measure the discharge of units of hydrostations was developed and tested by agencies of the State Standards Committee, and the system was introduced for conducting power tests of the units at the Bratsk hydrostation. An analysis of the systematic and instrumental errors enabled conducting the tests of the units at the Bratsk hydrostation with measurement of the discharge by a four-beam ultrasonic flowmeter with a maximum error of + or - 1% for a fiducial probability of P = 0.95. (Miller-PTT)
W89-01181

WATER SUPPLY YIELDS POWER,
O'Brien and Gere Engineers, Inc., Syracuse, NY.
R. Metzger, and J. B. Stobnicke.
Civil Engineering CEWRA9, Vol. 58, No. 5, p 60-62, May 1988. 3 fig.

Descriptors: *Water supply, *Water quality, *Water distribution, *Turbines, *Hydroelectric plants, Municipal water, Design Standards, Civil engineering.

The addition of a turbine to the water supply system in Pittsfield, Mass (U.S.A.) to power the city's water treatment plant is described. Where pressure reducing valves had been used in the supply system, a hydroelectric plant now generates up to 225 kw, operates between 2 and 14 cfs, and efficiently powers one of the city's water treatment plants. In addition to the hydro plant and the raw water transmission pipeline, the program included two water treatment plants and flow control stations. A 5 million gal. concrete tank, distribution booster stations and standpipes were placed in different parts of Pittsfield, and finally, a supervisory control and data acquisition system (SCADA) was installed. The computer based SCADA system allows for remote observation and control of the hydro plant, flow control stations, storage tanks and booster pumping stations. (Roseman-PTT)
W89-01254

LIGHTNING SPURS HYDRO REHAB,
Beck (R.W.) and Associates, Seattle, WA.
R. A. Hokenson.
Civil Engineering CEWRA9, Vol. 58, No. 5, p 69-71, May 1988. 1 fig.

Descriptors: *Hydroelectric plants, *Dams, Maintenance, Automation, Costs, Water mains.

A lightning strike at the Washington Water Power Co. (WWP) interconnection tie line to the Upriver Dam Hydroelectric Project in Spokane, Wash, resulted not only in extensive plant damage but unearthed flaws inherent in the plant's design. An approach consisting of seven construction contracts was used to stabilize the building and place the generating plant back on line. The seven contracts called for: rehabilitation work, including emergency repairs to the upstream cofferdam and dam abutments; rehabilitation of powerhouse No. 1; rehabilitation of civil works, such as retaining walls, parapet walls and engine-generator enclosure buildings; electro-mechanical and finish construction, including necessary repairs to the turbines in powerhouse No. 2; automation of the project, accomplished with a supervisory control and data acquisition (SCADA) system; cleanup, including road paving; water pipeline replacement, involving the replacement of two 36 in. diameter water mains washed away during the breach. Total cost for the seven phases approached $11 million; the rehabilitation of powerhouse No. 1 alone cost $3,350,000. (Roseman-PTT)
W89-01255

8D. Soil Mechanics

ASSIGNMENT OF THE CHARACTERISTICS OF CLAY-RUBBLE SOILS IN WATERTIGHT COMPONENTS OF EARTH DAMS,
V. V. Burenkova.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 7, p 401-407, January 1988. 6 fig, 12 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 7, p 17-21, July 1987.

Descriptors: *Earth dams, *Dams, *Hydraulic structures, *Soil physical properties, Soil density, Soil strength, Clay, Rubble, Soil stability.

Clay soils with coarse-grain inclusions (clay-rubble) are widely used as materials for watertight components in earth dams. Investigations of properties of such soils have been performed since 1968 in relation to a substantiation of their use as watertight components of the Nurek, Kolyma, Izobil'nyi, Rogun, Boguchany, and other dams. A determination of the design characteristics of soil related to an evaluation of strength, stability, and selection of the economic construction of a dam ultimately comes to assigning the necessary density of the soil in the dam body. The generalizing relations for determining the optimal density of clay-rubble soil as a function of the physical characteristics of fines and rubble-inclusions; assignment of the minimum allowable amount of fines of all varieties of clay-rubble soils used in watertight components of dams; determination of the necessary amount of enriching soil for a known content of fines in the soils being mixed and its minimum allowable content in the soil mixture was investigated. On the basis of the work performed, a generalizing relation for determining the optimal density of clay-rubble soils with various contents of fines, and its various physical and mechanical characteristics, is proposed. (Friedmann-PTT)
W89-00036

SELECTION OF A METHOD FOR COMPUTER-AIDED DESIGN OF EARTH DAMS,
N.A. Krasil'nikov.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 6, p 350-355, December 1987. 3 fig, 3 tab, 11 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 6, p 33-36, June 1987.

Descriptors: *Slope stability, *Computer models, *Earth dams, *Dam design, *Computer-aided design, Dam construction, Engineering geology, Design criteria, Hydraulic engineering.

Earth dams of modern hydro developments are being constructed under complex engineering-geologic conditions. Measures to ensure the stability of slopes both during construction and during operation are the main part of the design of these structures. In the modern hydraulic engineering literature considerable attention is devoted to selecting an engineering method of calculating these structures. At design organizations mass calculations of the stability of slopes of earth dams, embankments, etc., are being carried out with the aid of computers and with consideration of many complicating circumstances, but with the minimum participation of specialists in the area of engineering geology. Under these conditions the necessary accuracy of the calculation can be provided only if engineering methods checked by practice are used in the calculation, with careful consideration to limits and conditions of use. It is necessary to substantially increase the requirements imposed on the existing and newly developed engineering methods of calculating earth slopes which are to be used on computers. To provide calculation accuracy and structural reliability, these engineering methods should take into account requirements of a geological, technical, and economic character. (VerNooy-PTT)
W89-00056

EXCAVATION OF HEAVY SOILS BY DREDGES,
For primary bibliographic entry see Field 8H.
W89-00068

DEFORMATION OF DAMS WITH A FACING AND THEIR SEISMIC STABILITY,
M. E. Groshov, and V. N. Lombardo.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 4, p 207-214, October 1987. 8 fig, 2 tab, 6 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 4, p 27-33, April 1987.

Descriptors: *Dams, *Dam stability, *Earth dams, *Deformation, *Construction materials, *Asphalt, Rheology, Construction, Dam construction, Dam foundations, Hydraulic structures, Abutments, Reservoirs, Stress, Tensile stress, Facings, Strain.

The stress-strain state and seismic stability of a dam with a watertight asphalt facing was calculated. The calculations showed that in the construction period the maximum axial tensile strains occur in the lower part of the facing in the zone of abutment of the downstream slope of the dam to the foundation. They are practically independent of the scheme of constructing the dam and sequence of filling the reservoir. This makes it possible to place the facing during construction of the dam and to fill the reservoir as the facing is being placed. The maximum tensile strains of the facing caused by a seismic load are localized in the upper 6-m zone. They can reach 2.2-3.5% for peak accelerations of the seismic action of 10-15 m/sq sec. The additional tensile strains in the lower part of the facing for these accelerations do not exceed 0.5%. Earth dams with a facing have a high seismic stability. When an impervious facing is provided they can withstand a seismic action with a peak acceleration of 10-15 m/sq sec. (Doria-PTT)
W89-00070

SUBSOIL INVESTIGATION OF ICE LENSING AT THE CALGARY, CANADA, FROST HEAVE TEST FACILITY,
L.E.C. Engineering, Calgary (Alberta).
For primary bibliographic entry see Field 2C.
W89-00389

USE OF CLAY SOILS IN THE CONSTRUCTION OF CUTOFF CURTAINS,
P. F. Sobkalov.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 1, p 14-18, July 1987. 4 tab, 6 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 1, p 22-25, January 1987.

Descriptors: *Clays, *Construction, *Hydraulic engineering, *Cutoffs, *Structural engineering, Slurry trench method, Cutoff curtains, Soviet Union.

The problem of using local materials in hydrotechnical construction is quite urgent due to a striving for a reduction in the cost of construction and wide introduction of new technological developments proposing the use of local materials. The slurry trench method is one of the prospective methods which is being used successfully in hydrotechnical and industrial construction when building cutoff curtains and underground load-bearing structures. Despite the advantages of the slurry trench compared with other methods, it has not had sufficient development in hydrotechnical construction. One of the causes of the insufficient use of the slurry trench method is the presence of costly bentonite clays in the technological cycle when constructing the trench walls. There are two ways of solving this problem: (1) the development of recipes of hardening slurries on a base of bentonite clays suitable for a one-stage construction technology, and (2) replacement of bentonite clays by local ones preliminarily treated with chemical reagents and with mechanical cleaning. The second solution was tested by analyzing local clays and their suitability in the development of cutoff curtains. The use of local clays can considerably broaden the area of use of the slurry trench method for constructing cutoff curtains in the northern and northwestern regions of the Soviet Union. (Brock-PTT)
W89-00549

EFFECT OF SEEPAGE ON EARTH DAMS,

V. F. Kanarskii.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 1, p 19-21, July 1987. 3 fig, 3 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 1, p 26-27, January 1987.

Descriptors: *Seepage, *Earth dams, *Water level fluctuations, Dams, Cutoffs, Reinforced concrete.

Under conditions of daily fluctuations of the water levels in water bodies unsteady seepage is observed in the body of dams. The effect of this seepage was examined, especially with regard to the design of future earth structures. With a rise in water level, the inflow into soils of the structure from the upstream slope and outflow of seeping water into the foundation and drainage increase, reaching maximum values at the normal pool level. With a drop in water level, the inflow and outflow of seeping water decreases, and the seeping water remains in the body of the earth structure in the form of a seepage mound. In all investigated cases, the absence of effluent seepage on the upstream slope at a water level corresponding to the dead storage level, means that the protective coverings do not experience an uplift pressure. Under these conditions, a filterless, solid reinforced-concrete covering has reliably protected upstream slopes of dikes with fluctuating water levels. (Brock-PTT)
W89-00550

PROCEDURE FOR EVALUATING MUNICIPAL SOLID WASTE LEACHATE COMPONENTS CAPABLE OF CAUSING VOLUME SHRINKAGE IN COMPACTED CLAY SOILS,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5E.
W89-00621

LABORATORY ANALYSIS OF MUDFLOW PROPERTIES,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W89-00899

INTERACTION OF EARTHEN LINER MATERIALS WITH INDUSTRIAL WASTE LEACHATE,
Texas Univ. at Austin. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5E.
W89-00997

STABILITY OF SAND SLOPES IN THE GROUNDWATER DISCHARGE ZONES,
E. I. Mikhnevich.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 9, p 519-524, September 1988. 3 fig, 1 tab, 8 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 9, p 22-25, September 1987.

Descriptors: *Canals, *Slope stability, *Banks, *Seepage, *Surface-groundwater relations, Groundwater, Groundwater movement, Sand, Surface water, Slopes, Reclamation, Soviet Union, Mathematical equations, Base flow, Design criteria, Soil water.

The failure of sand slopes of reclamation canals and embankments, mainly due to the loss of local stability under the effect of ground and surface water, is discussed in quantitative terms. The height of effluent seepage (He) of groundwaters is an important calculation parameter needed for estimating local stability of the slopes of canals and earth structures and for designing their draining revetments (inclined drainage). A comparison of the existing formulas shows that the results of calculations differ considerably among themselves and from the experimental data. A theoretical relation is presented, that makes it possible to more accurately determine the He in single-layer soils with a slope coefficient of m > or = 1, various lengths of the seepage path, depth of the impervious bed, and the presence of water in the channel. Schemes for calculating the effect of forces in the groundwater discharge zone, by deriving theoretical relation and by deriving semiempirical formulas, are presented. (Miller-PTT)
W89-01174

EVALUATION OF THE RELIABILITY OF WAVE-PROTECTION SLAB REVETMENTS OF EMBANKMENT SLOPES,
I. N. Ivashchenko, L. V. Komel'kov, and V. B. Yancher.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 9, p 530-538, September 1988. 4 fig, 3 tab, 10 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 9, p 29-33, September 1987.

Descriptors: *Bank protection, *Performance evaluation, *Embankments, *Bank protection, *Performance evaluation, *Earth dams, *Evaluation, *Structural engineering, Hydraulic structures, Concrete dams, Slabs, Slopes, Quantitative analysis.

The service reliability of wave-protection slab coverings of slopes of earth dams and embankments was evaluated. The investigations were carried out for a sand-fill embankment with an approximate length of 18 km and an average height of 10 m. A modern approach to an evaluation of the state of an operating hydraulic structure based on a quantitative evaluation of its reliability is realized. This approach made it possible to express, in a single index, the possibility of the occurrence of three different types of limit state-of-the-wave protection revetment and to analyze their relative role in the formation of the reliability of the structure. The use of an engineering method of quantitative evaluation of reliability made it possible to simultaneously take into account the probability of deviation of several acting factors from the calculated values, as well as the probabilities of all possible combinations of the indicated factors. The method presented here also can be used for evaluating the reliability of reinforced-concrete facings of earth dams, apron slabs, and other analogous structures. (Miller-PTT)
W89-01176

SOME RESULTS OF INVESTIGATING THE STATE OF THE POWERHOUSE OF THE PLYAVINYAS HYDROELECTRIC STATION,
O. N. Nosova, L. G. Egorova, I. E. Shakars, and V. M. Yaunzema.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 9, p 552-558, September 1988. 4 fig, 5 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 9, p 42-46, September 1987.

Descriptors: *Foundations, *Plyavinyas Hydroelectric Plant, *Hydroelectric plants, *Inspection, *Hydraulic structures, Stress, Foundation failure, Soviet Union, Spillways, Soil creep, Tectonics, Risks, Drainage wells.

An on-site evaluation of the state of the spillway-type Plyavinyas hydroelectric station was conducted and verifying calculations of the stability, strength and displacements of the structure-foundation system were performed. The state of the powerhouse, at present, can be considered satisfactory. Examining the indices characterizing the stability and strength as a whole, it is noted that (1) uplift on the base of the powerhouse does not exceed the design values, (2) movements of the soil stratum under the right bank abutment are a local (3) deformations of the foundation (settlements, displacements) can be attributed to slowly developing processes, and (4) results of calculating the stability and the actual stresses in the anchoring fittings of the blanket indicate the presence of a sufficient factor of safety and stability of the powerhouse-foundation system. Since the causes of movement of the soil stratum are present still not completely clear and the relation between these movements and the slowly developing deformations is not understood, a long-range forecast of the state of the structure is practically impossible. Since the new row of drainage wells of the right slope proved to be ineffective, it is necessary to continue searching for the possibility of transferring the discharge zone of the Amata-Gauya horizon to a greater distance from the man structure. (Miller-PTT)
W89-01180

8E. Rock Mechanics and Geology

SEISMIC STRESS STATE OF UNDERGROUND STRUCTURES WITH CONSIDERATION OF THE EFFECT OF THE FREE SURFACE,
G. L. Khesin, I. K. Kostin, V. V. Nemchinov, and E. V. Yureneva.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 7, p 395-401, January 1988. 7 fig, 1 tab, 6 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 7, p 13-17, July 1987.

Descriptors: *Seismic properties, *Underground structures, *Hydroelectric plants, *Stress analysis, Geology, Soviet Union, Tensile stress, Stress, Computer programs, Mathematical analysis.

Underground hydraulic structures are located at depths commensurate with seismic wavelengths, and therefore the free surface participates in the formation of the seismic stress state around underground structures. The effect of the free surface is observed even in the case of such underground structures as the machine hall of the Rogun hydroelectric station, located at a depth of 350 m. An investigation was conducted that made it possible to trace the regularities of the change in stresses with depth in the simplest case of a semiinfinite elastic solid with reflection of plane waves from a smooth free surface. The study resulted in a computer program (a main program and four subprograms) for determining stresses at any point of an elastic mass near a surface of arbitrary configuration under the effect of waves of an arbitrary type. It was found that the direction of the seismic ray phi = 25 degrees is the worst for the given structure, since substantial tensile stresses occur in the roof and floor of the working. An analogous picture also occurs for ray direction phi = 90 degrees, but values of the tensile stresses in this case are less. The method broadens the possibility of calculating stress states of underground structures since it permits taking into account the effect of the free surface and character of the seismic effect. (Friedmann-PTT)
W89-00035

CALCULATION OF SEISMIC SAFETY OF TUNNELS DURING BLASTING,
M. I. Shuifer.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 7, p 408-410, January 1988. 1 tab, 6 fig. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 7, p 21-23, July 1987.

Descriptors: *Seismic properties, *Tunnels, *Excavation, *Hydroelectric plants, Hydraulic engineering, Construction, Hydraulic structures, Stress, Safety, Rapid excavation.

In the construction of power facilities on rock foundations, simultaneous blasting excavations of underground complexes and pits on the surface is widely developed. The requirements of intensification of construction are being realized by increasing the power of the explosions and bringing together simultaneously the workings being driven and those being operated. A rational approach to an engineering solution of this problem was attempted through calculations that generalize and typify the empirical data of seismometric and macroseismic observations. Approximate calculations do not account for the special conditions of formation of the dynamic stress field in completely structured masses. For the calculated distances, the seismic effects of explosions should be regarded as an essentially small additional (to the constantly acting static) loading of the object. (Friedmann-PTT)
W89-00037

PROSPECTS OF IMPROVING THE PREDICTION OF THE HAZARD OF ROCK BURSTS DURING TUNNELING,
M. G. Bikineev, A. D. Bondarenko, B. A. Lysikov, G. A. Lczobko, and I. F. Ponomarev.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 7, p 410-414, January 1988. 2 tab, 3 ref. Trans-

lated from Gidrotekhnicheskoe Stroitel'stvo, No. 7, p 23-26, July 1987.

Descriptors: *Tunneling, *Excavation, *Safety, *Construction, *Hydraulic structures, *Underground structures, Mathematical equations, Prediction, Drilling, Engineering, Risks, Geology, Hydraulic.

A study of the regularities of the change in the properties of a volcanogenic burst-hazardous rock mass showed that the cause of occurrence of rock and gas bursts is fracture of the rocks by blasting operations in hazardous zones, which are characterized by an increased rock pressure, gas saturation, and reduced strength of the rock mass. In this case, unity of the nature of the burst hazard of igneous and sedimentary rocks, bursts of which have been known in the Donbas for several decades, was established. On the basis of investigations, indices characterizing the burst hazard of igneous rocks were determined, which made it possible to solve the main problem of providing safety of tunneling operations. An equation for the prediction of the upper limit of rock burst hazard is presented. Use of this prediction makes it possible to provide a decrease of nonproductive expenditures with the minimum necessary volumes of drilling exploratory holes. Along with its use, it is necessary to improve the prediction of burst hazard based on a three-stage prediction. This will provide safety of tunneling operations and will make it possible to take into account in greater detail the factors of burst hazard when designing and constructing underground hydraulic structures according to the selected technology. (Friedmann-PTT)
W89-00038

GAS SHOWS DURING CONSTRUCTION OF HYDRAULIC TUNNELS,
V. K. Razumov, and S. I. Skiba.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 4, p 215-219, October 1987. 1 fig, 4 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 4, p 34-37, April 1987.

Descriptors: *Rock gases, *Tunnel construction, *Rock excavation, *Hazards, *Engineering geology, Tunnels, Hydraulic structures, Costs, Construction costs, Rock properties, Excavation, Engineering, Safety, Soviet Union, Methane, Carbon dioxide.

Examples are presented to indicate that, when driving tunnels in the Caucasus regions, builders often come across gas releases, mainly methane and carbon dioxide. The presence of gas-containing or gas-conducting rocks along routes of tunnels has a considerable effect on construction time and cost and also requires the introduction of special safety measures and the conversion of the work to a gas regime. When driving tunnels, it is necessary to carry out thorough engineering-geological documentation. Upon a change in the mining-geological conditions compared with the design conditions, it is necessary to revise the forecasts on possible gas shows and to introduce corrections in the methods of tunneling, supporting the workings, and checking the state of the underground atmosphere. (Doria-PTT)
W89-00071

CERTAIN CHARACTERISTICS OF CALCULATING ANGULAR RETAINING WALLS,
For primary bibliographic entry see Field 8A.
W89-00076

TRANSIENT PRESSURES IN HYDROTECHNICAL TUNNELS DURING EARTHQUAKES,
University of Southern California, Los Angeles.
S. B. Kojic, and M. D. Trifunac.
Earthquake Engineering and Structural Dynamics IJEEBG, Vol. 16, No. 3, p 523-539, April 1988. 10 fig, 16 ref.

Descriptors: *Earthquakes, *Seismic properties, *Tunnels, *Hydraulic structures, *Underground structures, Mathematical studies, Dams, Hydrostatic pressure, Reservoirs, Hydrodynamics, Resistivity, Strength.

Transient pressures generated by earthquake shaking in hydrotechnical tunnels were evaluated by the discrete Fourier transform sequence. The effects of the horizontal ground motion accelerating the closed downstream tunnel gate, as well as the upstream dam face, and the influence of the vertical motion of the reservoir floor are considered. It is shown that high hydrodynamic pressures can be developed, several times larger than the hydrostatic pressure. (Author's abstract)
W89-00448

CALCULATION OF PRESSURE TUNNEL LININGS WITH CONSIDERATION OF CONSOLIDATION GROUTING OF THE ROCKS,
For primary bibliographic entry see Field 8C.
W89-00547

DETERMINATION OF THE MECHANICAL CHARACTERISTICS OF ROCKS BY THE METHOD OF VOLUME CONFINEMENT OF DEFORMATIONS,
A. S. Morozov.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 1, p 9-13, July 1987. 4 fig, 5 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 1, p 19-22, January 1987.

Descriptors: *Rock mechanics, *Engineering geology, *Hydraulic engineering, *Construction, Mathematical analysis, Rock properties, Stress-Strain state.

For designing and constructing hydraulic structures on a rock foundation under complex engineering-geologic conditions it is important to predict the behavior of the rock mass which is the foundation of the structure under a load. At present such a prediction is made on the basis of analyzing the stress-strain state of the foundation-structure system by numerical methods. An important role in this case is played by the mechanical properties of the rock determined in a volume stress state up to the ultimate strength and after the start of macro fracturing. These properties should be determined with consideration of a constant change in stress state of the investigated volume of rock, which occurs inside the rock mass of the foundation due to confinement of the deformation of individual elements. Of particular importance is the application of the values of the mechanical strength and modulus of deformation obtained to large volumes of rocks interacting with the engineering structure. A method is proposed for testing rocks under conditions of volume confinement of deformations, which makes it possible to obtain the penultimate and ultimate moduli of deformation of rock from tests of one specimen. The possibilities of the method were demonstrated for sandstones of the Zelenchuk hydrostation from the zone of hydraulic pressure tunnels. (Brock-PTT)
W89-00548

EXPERIENCE IN DETERMINING THE NUMERICAL CHARACTERISTICS OF LANDSLIDE MOVEMENTS,
For primary bibliographic entry see Field 8A.
W89-00551

ESTIMATION OF THE RELIABILITY OF EARTH DAMS WITH CONSIDERATION OF SEISMIC LOADS,
N. A. Isakhanyan, V. S. Pepoyan, A. P. Troitskii, and S. G. Shul'man.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 1, p 51-58, July 1987. 18 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 1, p 51-55, January 1987.

Descriptors: *Dams, *Seismic properties, *Construction, *Hydraulic engineering, *Mathematical models, Structural engineering, Earth dams, Reliability.

Earth dams are widely used in hydrotechnical construction practice, including in seismically active regions, and problems of ensuring their strength and reliability remain urgent. Methods are given for estimating the reliability of earth dams under seismic loads in the framework of simplified models: quasistatic (linear spectral) theory of seismic stability and the Newmark scheme. The methods permit an approximate consideration of the effect of the main factors determining the reliability of a structure: intensity and frequency of earthquakes, life of the structure, water level in the upstream and downstream pools, character of information about the deformation and strength parameters of the soils, models of limit states, etc. The characteristics of reliability (probability of no failure) obtained can be used for comparing different variants of structures as well as for comparison with certain available characteristics of reliability (obtained on the basis of the statistics of failure and damages of structures of the given type). (Brock-PTT)
W89-00557

COMPLEX GEOLOGY LEADS TO AN UNUSUAL DESIGN FOR THE LAKHWAR DAM,
Irrigation Design Organization, Roorkee (India).
C. K. Agrawal, and B. M. Arora.
International Water Power and Dam Construction IWPCDM, Vol. 40, No. 8, p 28-32, August 1988. 6 fig, 2 tab.

Descriptors: *Foundation racks, *Yamuna River, *Hydroelectric plants, *India, *Gravity dams, *Hydraulic structures, *Design criteria, Project planning, Electric powerplants, Spillways, Engineering, Himalaya Mountains, Lakhwar, Peaking capacity, Diversion structures, Dam construction, Tunnels.

The 204 m-high Lakhwar concrete gravity dam is at present under construction in the Himalayas, harnessing the waters of the Yamuna river in India to generate 300 MW of peaking power in an underground powerhouse located in the right abutment. The project is scheduled for completion in 1995. The difficult foundation conditions have led to several changes from the original layout and shape of the project. sign of the dam section and energy dissipation arrangements are described. Aspects of the project highlighted include section design of the dam, the Lakhwar spillway, the underground machine hall, two river diversion tunnels, concrete placement, and progress of the works overall. (Author's abstract)
W89-01005

IMPROVEMENT OF THE LAYOUTS AND DESIGN OF UNDERGROUND HYDRAULIC STRUCTURES,
V. M. Mostkov, and V. F. Ilyushin.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 9, p 509-514, September 1988. 5 fig, 6 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 9, p 14-18, September 1987.

Descriptors: *Underground structures, *Tunnel construction, *Hydraulic structures, *Structural engineering, *Structural geology, Surge tanks, Gates, Tunnels, Construction, Soviet Union, Hydroelectric plants, Design criteria.

Ways to improve layouts and designs of underground hydrotechnical construction are examined in three ways: (1) combination of diversion and service tunnels, (2) use of structural elements involving the rock mass in being worked, and (3) use of precast and precast-cast in situ underground structural elements. In Soviet practice of recent years, there are many examples of the successful combination of underground hydraulic structures (gate chambers and surge tanks, machine halls and transformer rooms, tunnels of various purpose). Improvement of the layouts and designs by combining the functions of tunnels, using designs involving the surrounding rock and precast structural elements, is an important reserve of scientific and technological progress. The advantage of the described designs compared with the traditional ones is the ability to transmit part of the loads to the surrounding rock mass and to reduce the consumption of materials for the tunnel. The use of precast and precast-cast in situ linings of hydraulic tunnels is unquestionably progressive and should find wider use. Since the majority of progressive

designs are possible only if a smooth contour of the workings is provided and because overbreak of rock and overplacement of concrete harmful, it is necessary to develop and introduce an effective technology of smooth blasting in the Soviet underground construction for the most characteristic engineering-geological conditions. (Miller-PTT)
W89-01172

8F. Concrete

TECHNOLOGY OF CASTING PRECAST PIPELINE ELEMENTS OF THE KAISIADORY'S PUMPED-STORAGE STATION,
A. D. Osipov, N. V. Yudina, R. A. Yakubonis, I. M. Velanishkis, and O. B. Lyapin.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 7, p 436-441, January 1988. 1 fig, 3 tab. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 7, p 42-46, July 1987.

Descriptors: *Hydraulic structures, *Pipelines, *Concretes, *Plastics, Chemical properties, Construction, Pumped storage, Economic aspects.

The Soviet construction industry widely used superplasticizers, technological additives to the concrete mix having properties of (1) brief effective dilution of the concrete mix for 1.5-2.0 h from the time of mixing, and (2) not affecting the structural and deformational properties of the concrete, since it does not enter into chemical reactions occurring in the concrete during its hardening. The substantiation of the use of the plasticizers S-3 and 'Dofen' for obtaining a self-compacting concrete cast concrete mix was investigated. Development of the self-compacting concrete mix, investigations of the properties of the cast concretes, and technology of their placement were studied as applied to the precast elements of the pipelines of the Kaisiadorys pumped-storage station, for the purpose of eliminating the operation of compacting the concrete mix. Results of the experiment indicated that the use of a cast concrete mix with a superplasticizer for concreting structures is technically expedient and economically effective. (Friedmann-PTT)
W89-00045

WORKS OF S. V. SHESTOPEROV ON FROST RESISTANCE OF HYDROTECHNICAL CONCRETE,
F. M. Ivanov.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 6, p 377-380, December 1987. 3 fig, 7 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 6, p 55-57, June 1987.

Descriptors: *Concrete technology, *Freeze-thaw tests, *Concrete testing, *Biographies, Frost protection, Soviet Union, History.

Sergei Vladimirovich Shestoperov (1904-1984) is known as a prominent scientist in the area of concrete technology. He devoted a considerable part of his work to investigations in the area of the durability, particularly frost resistance, of hydrotechnical concrete. As long ago as the early 1930s, Shestoperov undertook extensive experimental investigations of the frost resistance of concrete for the construction of the Moscow Canal. Shestoperov devoted special attention to a study of the role of the mineralogical composition of cement in creating a frost-resistant concrete structure. The results of his extensive experimental investigations were made into a monograph and republished several times. A characteristic feature of Shestoperov's works was the scale of his experiments. As long ago as 1940 tests involving several thousand concrete specimens were undertaken under natural conditions. Shestoperov was an enthusiastic investigator and his activities in the area of concrete technology and investigations of the durability of concrete promoted the technical progress of construction in the Soviet Union. (VerNooy-PTT)
W89-00061

EFFECTS OF THREE ORGANICS ON SELECTED PHYSICAL PROPERTIES OF TYPE I PORTLAND CEMENT,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5E.
W89-00994

TRANSMISSION ELECTRON MICROSCOPIC STUDY OF SOLIDIFIED/STABILIZED ORGANICS,
Louisiana State Univ., Baton Rouge. Hazardous Waste Research Center.
For primary bibliographic entry see Field 5E.
W89-01000

EVALUATION OF THE RELIABILITY OF WAVE-PROTECTION SLAB REVETMENTS OF EMBANKMENT SLOPES,
For primary bibliographic entry see Field 8D.
W89-01176

CHARACTERISTICS OF THE ORGANIZATION AND PERFORMANCE OF WORKS IN THE DAM FOUNDATION OF THE AL-HADITHAH HYDRO DEVELOPMENT (IRAQ),
N. V. Dmitriev, L. I. Malyshev, V. A. Ashikhmen, and D. A. Kalinkevich.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 9, p 563-569, September 1988. 3 fig, 3 tab, 2 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 9, p 53-56, September 1987.

Descriptors: *Al-Hadithah Hydro Development, *Dam construction, *Dams, *Dam foundations, *Grouting, *Drilling, Hydroelectric plants, *Iraq, Technology, Foreign aid, Performance evaluation.

The construction of a grout curtain with a depth of 90 m and front length of 8920 m made in the foundation of the retaining structures of the al-Hadithah (Iraq) is discussed. Work on creating the curtain in the dam foundation begin in early 1978 and continued to December 1984. The grout curtain was arbitrarily divided into right-bank, left-bank, and channel stretches. Information on the amount of work on the curtain stretches and data on the consumption of materials are given. The performance of the massive grouting operations within the prescribed time and with a high quality was possible only thanks to maximum industrialization of industry and technology. The drilling and grouting equipment manufactured in the USSR showed a high operating reliability. The methods and technology of the grouting works used should be recognized as the most economical from the viewpoint of the time and quality of the work. They can be recommended for use under conditions of Soviet hydrotechnical construction. (Miller-PTT)
W89-01182

8G. Materials

MANUFACTURE OF POLYETHYLENE SEALS FOR HIGH-HEAD GATES OF HYDRAULIC STRUCTURES,
For primary bibliographic entry see Field 8G.
W89-00043

MANUFACTURE OF POLYETHYLENE SEALS FOR HIGH-HEAD GATES OF HYDRAULIC STRUCTURES,
V. N. Otmakhov, and G. A. Ryabtsev.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 7, p 429-432, January 1988. 4 fig, 4 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 7, p 37-39, July 1987.

Descriptors: *Materials engineering, *Hydraulic machinery, *Plastics, *Economic aspects, *High pressure gates, Mechanical equipment, Plastics, Cold weather construction, Technology, Hydraulic structures.

As a result of experiments conducted at the Moscow Special Design Department of Stell Hydraulic Structures ('Mosgidrostal') it was established that gates with seals made of low-density polyethylene (PE) of grade 15803-020 of State Standard GOST 16337-77 make it possible to reliably close outlets of hydraulic structures with heads of 200 m and more, and the higher frost resistance than that of rubber, will make it possible to use PE seals on hydraulic structures in the cold climatic zone of the USSR (Yakutia and regions adjacent to it). The experiments completely confirmed the possibility of the high-quality manufacture of the seals of high-head gates from low-density PE delivered in the form of granulated raw material by the injection molding method. In the future, the use of PE seals will be extended to medium heads (20-40 m) by creating a special profile. Thus a range of heads from 20 to 250 m will be provided just by two types of PE seals, whereas at present, 10-11 types of rubber seals are used for covering the range of heads up to 140 m. Since the process of manufacturing PE seals can be maximally mechanized and automated, unlike the manufacture of rubber seals, the replacement of rubber seals with PE seals will produce a definite economic effect due to reduction of stock molds and introduction of this energy-saving technology. (Friedmann-PTT)
W89-00043

EFFECTIVE COATINGS FOR HYDRAULIC STRUCTURES,
I. K. Khamitov, Y. A. Sokolova, E. M. Gotlib, and A. A. Filip'ev.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 4, p 240-242, October 1987. 3 tab, 7 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 4, p 50-52, April 1987.

Descriptors: *Coatings, *Hydraulic structures, *Waterproofing, *Polymers, *Resins, Performance evaluation, Technology, Corrosion, Alkaline water, Linings.

A phenol-resorcinol-formaldehyde resin (PRF-50) hardened by 11 parts by weight of paraformaldehyde for 28 days at room temperature was investigated for use as a waterproofing coating for hydraulic structures. The use of VPP (a by-product of isoprene production) as a modifier, in combination with a filler, such as ground quartz sand, greatly increases strength and deformation resistance. The most corrosive medium was weakly alkaline solutions; the least were water and acid and sodium chloride solutions. It is concluded that the modified resin is an effective composite material with a high protective ability, crack resistance, and impact strength, suitable for creating reliable and durable waterproofing of buildings and structures. (Doria-PTT)
W89-00075

PERFORMANCE OF BURIED SMALL PIPES,
McMaster Univ., Hamilton (Ontario). Dept. of Civil Engineering and Engineering Mechanics.
For primary bibliographic entry see Field 8A.
W89-00754

LABORATORY ANALYSIS OF MUDFLOW PROPERTIES,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W89-00899

LEACHING OF INORGANIC HAZARDOUS CONSTITUENTS FROM STABILIZED/SOLIDIFIED HAZARDOUS WASTES,
Cincinnati Univ., OH. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5E.
W89-00999

ULTRASONIC FLOWMETER FOR TESTING UNITS OF LARGE HYDROELECTRIC AND PUMPED-STORAGE STATIONS,
For primary bibliographic entry see Field 8C.
W89-01181

8H. Rapid Excavation

CALCULATION OF SEISMIC SAFETY OF TUNNELS DURING BLASTING,
For primary bibliographic entry see Field 8E.
W89-00037

PROSPECTS OF IMPROVING THE PREDICTION OF THE HAZARD OF ROCK BURSTS DURING TUNNELING,
For primary bibliographic entry see Field 8E.
W89-00038

EXCAVATION OF HEAVY SOILS BY DREDGES,
D. V. Roshchupkin.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 4, p 194-197, October 1987. 3 fig, 9 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 4, p 19-21, April 1987.

Descriptors: *Excavation, *Dredging, *Hydraulic machinery, *Soil engineering, *Construction equipment, *Construction methods, Soil management, Soil physical properties, Soil texture, Soil types, Engineering, Design criteria, Cutters.

Methods are reviewed for excavating heavy soils not amenable to erosion by dredges by means of cutters. Recent design improvements are discussed, and different types of cutters are compared. It is concluded that, for excavating dense, noncohesive soils (with or without interlayers of cohesive soils), the dredge should be equipped with a two-rotor cutter with toroidal-sector buckets; for excavating all types of cohesive soils, from light loams to dense, sticky, stiff clays, the dredge should be equipped with a milling cutter with helical moldboard-cutting blades. The hyperbolic-spiral milling cutter is a promising development that should be put into use. (Doria-PTT)
W89-00068

CHINA'S EXPERIENCE WITH UNDERGROUND WORKS,
Ministry of Water Conservancy and Power, Beijing (China). Water Resources and Hydropower Planning and Design Inst.
G. Zongyan.
International Water Power and Dam Construction IWPCDM, Vol. 40, No. 8, p 39-41, August 1988. 3 fig, 2 tab.

Descriptors: *Hydroelectric plants, *Hydraulic structures, *Underground powerplants, *China, Hydraulic equipment, Hydraulic engineering, Tunnel construction, Tunneling, Tunnels, Construction methods.

About 180 major tunnels for hydro plants and 30 underground powerhouses have been built in China over the last 40 years, and experience has now been gained in a number of tunnelling techniques. Achievements and progress to date are outlined, with examples of some of the underground works for hydro plants either already completed or under construction. At present, 27 large- and medium-sized hydroelectric power stations are under construction; of these, four stations incorporate long power tunnels. Recently, various new techniques and equipment have been used in Chinese hydroelectric underground engineering work. Examples of these include smooth blasting, presplit blasting, and the use of prestressed anchorage cables. Equipment now being used includes TBMs with a diameter of 5.8-10.8 m, Alimak raise climbers, raise borers with diameter 2.4 m, and rubber-tired drilling jumbos. (Author's abstract)
W89-01007

AUTOMATION OF CONVEYOR TRANSPORT AT THE CONSTRUCTION SITE OF EARTH DAMS,
V. V. Vil'vovskii, E. L. Mikhailovskii, and Y. S. Grebenshchikov.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 9, p 515-519, September 1988. 2 fig, 4 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 9, p 18-21, September, 1987.

Descriptors: *Soviet Union, *Dam construction, *Automation, *Excavation, *Conveyance structures, Economic impact, Computers, Dams, Reliability, Construction, Earth dams, Mining.

The experience of the Soviet Union in the operation of conveyor transport in the mining industry, and its use in hydrotechnical construction for moving earth materials from borrow pits to dams, is analyzed. The introduction of conveyor transport in Soviet industry when constructing earth dams will make it possible to: (1) reduce the costs of transporting earth materials, (2) reduce the need for vehicles, (3) increase the rate of delivering earth materials from borrow pits for constructing dams, (4) reduce the volume of construction on housing, cultural and personal services, and subsidiary facilities, (5) construct a smaller number of roads with a heavy duty pavement for large dump trucks, (6) to increase the technical level of performing earthworks, and (7) to provide integrated automation of all technological processes of constructing the dam based on the use of modern equipment, including computers. Automation of conveyor transport will make it possible to considerably increase the economic effect from using conveyor transport due to an increase of no-failure operation, an increase of operating reliability, a reduction of labor and energy resources and a decrease in the shutdown time of the borrow pit and equipment placing the materials in the dam (because of failure of conveyor transport). (Miller-PTT)
W89-01173

8I. Fisheries Engineering

FISH COMMUNITIES IN RESERVOIRS IN SOUTHERN BRAZIL (COMUNIDADES DE PEIXES DE RESERVATORIOS NO SUL DO BRASIL),
Sao Paulo Univ., Ribeirao Preto (Brazil). Faculdade de Filosofia, Ciencias e Letras.
For primary bibliographic entry see Field 2H.
W89-00011

SPATIAL AND TEMPORAL VARIABILITY OF THE INDEX OF BIOTIC INTEGRITY IN THREE MIDWESTERN STREAMS,
Illinois Univ. at Urbana-Champaign. Dept. of Ecology, Ethology and Evolution.
For primary bibliographic entry see Field 2E.
W89-00026

INFLUENCE OF TEMPERATURE ON MICROHABITAT CHOICE BY FISHES IN A CALIFORNIA STREAM,
California Univ., Davis. Dept. of Wildlife and Fisheries Biology.
For primary bibliographic entry see Field 2H.
W89-00027

EUTROPHICATION EFFECTS OF PREY SIZE AND FOOD AVAILABLE TO YELLOW PERCH IN LAKE ERIE,
Ohio Cooperative Fishery Research Unit, Columbus.
For primary bibliographic entry see Field 5C.
W89-00030

FEEDBACK DEPENDENCE BETWEEN THE EUTROPHICATION PROCESS AND CHANGES IN THE FISH COMMUNITY: THE THEORY OF ICHTHYOEUTROPHICATION (SPRZEZENIE ZWROTHE MIEDZY PROCESUM EUTROFIZACJI A ZMIANAMI ZESPOLU RYB. TESRI ICHTIOEUTROFIZACJI),
Instytut Rybactwa Srodladowego, Piaseczno (Poland). Zabieniec Centre.
For primary bibliographic entry see Field 5C.
W89-00031

PRESERVATION OF NATURAL FISH REPRODUCTION DURING HYDROTECHNICAL CONSTRUCTION ON RIVERS,
G. G. Gangardt, B. S. Malevanchik, and L. P. Mikhailov.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 4, p 199-206, October 1987. 6 fig. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 4, p 22-27, April 1987.

Descriptors: *Fish management, *Fish conservation, *Construction, *Hydroelectric plants, *Stream fisheries, Spawning, Fish, Conservation, Locks, Fisheries, Rivers, Migration, Fish migration, Hydraulic structures, Fish passages, Soviet Union.

Technologies of preserving natural fish reproduction in inland water bodies under intense hydrotechnical construction in the Soviet Union are reviewed. These include: (1) fish passageways, including the world's first single-lane fish lock with continuous attraction of fish, as well as a mechanical fish hoist with a fish chute; (2) devices for diverting fish from water intakes, including fish-protection concentrating structures with horizontal separation of fishes, and those with vertical separation of fishes; and (3) the development of new types of artificial spawning grounds, including use of prefabricated spawning panels with an artificial substrate. The use of the various methods at different sites is described. (Doria-PTT)
W89-00069

ATTEMPT TO ESTIMATE THE FISH STOCK AND THE SUSTAINABLE YIELD OF LAKE ZIWAY AND LAKE ABAYA, ETHIOPIAN RIFT VALLEY,
For primary bibliographic entry see Field 2H.
W89-00178

PRIMARY PRODUCTION IN LAKES WITH CAGE TROUT CULTURE,
Wyzsza Szkola Nauczycielska w Slupsku (Poland). Dept. of Chemistry.
For primary bibliographic entry see Field 2H.
W89-00238

SORPTION OF CATIONS BY BOTTOM SEDIMENTS OF SZCZYTNO MALE AND LETOWO LAKES, WITH CAGE TROUT CULTURE,
Wyzsza Szkola Nauczycielska w Slupsku (Poland). Dept. of Chemistry.
For primary bibliographic entry see Field 2H.
W89-00239

NITROGEN AND PHOSPHORUS BALANCE IN LAKE SZCZYTNO MALE,
Wyzsza Szkola Nauczycielska w Slupsku (Poland). Dept. of Chemistry.
For primary bibliographic entry see Field 2H.
W89-00240

HYDROCHEMICAL STUDY OF LAKE SZCZYTNO MALE WITH TROUT CAGE CULTURE,
Wyzsza Szkola Nauczycielska w Slupsku (Poland). Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W89-00241

TESTING THE SECONDARY TREATMENT OF EFFLUENTS FROM THE 'POLICE' CHEMICAL PLANT IN CARP PONDS,
Akademia Rolnicza w Szczecinie (Poland). Dept. of Hydrobiology.
For primary bibliographic entry see Field 5D.
W89-00255

CHLOROPHYLL RELATIONSHIPS IN LETOWO AND SZCZYTNO MALE LAKES, WITH TROUT CAGE CULTURE,
Wyzsza Szkola Nauczycielska w Slupsku (Poland). Dept. of Chemistry.
For primary bibliographic entry see Field 2H.
W89-00262

HABITAT SUITABILITY AND FISH PRODUCTION: A MODEL EVALUATION FOR ROCK BASS IN TWO VIRGINIA STREAMS,
Virginia Cooperative Wildlife Research Unit, Blacksburg.
For primary bibliographic entry see Field 2H.
W89-00294

RISK ANALYSIS FOR FISH DIVERSION EXPERIMENTS: PUMPED INTAKE SYSTEMS,
Great Salt Bay Experimental Station, Damariscotta, ME.
R. I. Fletcher.
Transactions of the American Fisheries Society TAFSAI, Vol. 114, No. 5, p 652-694, September 1985. 18 fig, 48 ref, 4 append.

Descriptors: *Diversion structures, *Fish, *Intakes, *Risk assessment, *Ecological effects, Mortality, Fish migration, Barrier screens, Model studies, Fish barriers.

Such facilities as power-generating stations, public water systems, and ore-processing plants draw off large quantities of water from estuaries, coastal seawaters, lakes, and rivers. In turn, large numbers of fish are often drawn into these pumped intake systems and killed if not otherwise removed or diverted. The large mortalities associated with many intake systems threaten the perpetuation of indigenous stocks. Such passive devices as angled barrier screens are thought to guide fish in some way into pumped bypassing ducts, but an analysis of existing data supports instead a hypothesis of random encounter whereby the activities of entrapped fish are governed by the probabilistic mechanics associated with random walks and unlike boundary conditions. Experimental designs for separating and assessing time-dependent risks are developed for the case of competing devices in a given test system. From time-dependent comparisons between large and small systems (in particular, between a model system and its full-scale prototype), the net decrease in the probability of fish survival associated with increased system size is shown to be the consequence of increased exposure to the risk of death (increased residence time) rather than the consequence of increases in the unit risk of death itself. Where extensions of small-sale empirical results to full-scale system designs are wanted, arithmetic extrapolations yield erroneous results. Because displacement dependence (fish movement and system size) enters the risk analysis, the scaling problem must be resolved instead from a corresponding system of partial differential equations. (Lantz-PTT)
W89-00318

EFFECTS OF POLYCULTURE AND MANURE FERTILIZATION ON WATER QUALITY AND HETEROTROPHIC PRODUCTIVITY IN MACROBRACHIUM ROSENBERGII PONDS,
Hawaii Univ., Honolulu. Dept. of Oceanography.
B. A. Costa-Pierce, S. R. Malecha, and E. A. Laws.
Transactions of the American Fisheries Society TAFSAI, Vol. 114, No. 6, p 826-836, November 1985. 3 fig, 4 tab, 53 ref.

Descriptors: *Aquaculture, *Manure, *Fertilization, *Ponds, *Productivity, Water quality, Carp, Water hyacinths, Prawns, Nitrogen compounds, Dissolved oxygen, Biomass, Phosphorus, Agricultural wastes.

Water quality effects of high densities of silver carp Hypophthalmichthys molitrix, grass carp Ctenopharyngodon idella, and water hyacinths Eichhornia crassipes in semi-intensive pond culture of prawns Macrobachium rosenbergii were examined. Additional effects of isonitrogenous additions (8 kg N/ha/wk) of dried chicken manure and chicken broiler feed were evaluated. Excretion, grazing, and sediment resuspension by the carp stimulated phytoplankton productivity and turnover rates of microplankton, led to high early-morning dissolved oxygen (DO) concentrations, and in the ponds fed manure, increased phytoplankton biomass. Removal of phosphorus from the water by water hyacinths led to reduced chlorphyll-a concentrations, primary productivity, and microplankton turnover, and to low morning DO concentrations: in hyacinth ponds fed chicken broiler feed, there were large percentage fluctuations in phytoplankton biomass. Additions of manure stimulated autotrophic productivity about 3.0 times, and total microbial productivity about 4.6 times, more than additions of chicken feed. Biological control of phytoplankton dynamics and maintenance of DO concentrations at high phytoplankton standing crops by Chinese carp appears to be a viable alternative to present methods of water quality control in semi-intensive prawn aquaculture. (Author's abstract)
W89-00327

EFFECTS OF TEMPERATURE AND STREAMFLOW ON TIME AND DURATION OF SPAWNING BY SMALLMOUTH BASS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Fisheries and Wildlife Sciences.
For primary bibliographic entry see Field 2H.
W89-00373

HOMING OF ADULT CHINOOK SALMON AFTER BRIEF EXPOSURE TO WHOLE AND DISPERSED CRUDE OIL,
For primary bibliographic entry see Field 5C.
W89-00375

SUMMARY OF REPORTED FISH KILLS IN KANSAS DURING 1982,
Kansas Fish and Game Commission, Pratt. Fisheries Div.
For primary bibliographic entry see Field 5C.
W89-00393

MASS MORTALITY OF FISH ASSOCIATED WITH LOW SALINITY CONDITIONS IN THE BOT RIVER ESTUARY,
Cape Town Univ. (South Africa). Dept. of Zoology.
For primary bibliographic entry see Field 2L.
W89-00664

CHANGES IN THE FISH FAUNA OF THE BOT RIVER ESTUARY IN RELATION TO OPENING AND CLOSURE OF THE ESTUARY MOUTH,
Cape Town Univ. (South Africa). Dept. of Zoology.
For primary bibliographic entry see Field 2L.
W89-00665

EXPLOITED FISH AND SHELLFISH SPECIES IN THE MORAY FIRTH,
Marine Lab., Aberdeen (Scotland).
For primary bibliographic entry see Field 2L.
W89-00779

SEA AND FRESH WATERS,
Marine Lab., Aberdeen (Scotland).
For primary bibliographic entry see Field 2L.
W89-00797

STATUS OF FISH POPULATIONS IN THE CLYDE ESTUARY,
Clyde River Purification Board, East Kilbride (Scotland).
For primary bibliographic entry see Field 2L.
W89-00809

BIOLOGY AND MANAGEMENT OF HERRING AND OTHER PELAGIC FISH STOCKS IN THE FIRTH OF CLYDE,
Marine Lab., Aberdeen (Scotland).
For primary bibliographic entry see Field 2L.
W89-00825

MIGRATORY SALMONIDS OF THE ESTUARY AND FIRTH OF CLYDE,
Clyde River Purification Board, East Kilbride (Scotland).
For primary bibliographic entry see Field 5G.
W89-00828

INTERANNUAL VARIABILITY IN CLIMATE AND FISHERIES IN TASMANIA,
Commonwealth Scientific and Industrial Research Organization, Hobart (Australia). Marine Labs.
For primary bibliographic entry see Field 2A.
W89-00847

PLUNGING AND STREAMING FLOWS IN POOL AND WEIR FISHWAYS,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W89-00904

FISH AND FISHERIES OF REGULATED RIVERS IN THE UK,
Institute of Terrestrial Ecology, Huntingdon (England). Monks Wood Experimental Station.
R. H. K. Mann.
Regulated Rivers Research and Management RRRMEP, Vol. 2, No. 3, p 411-424, July-August 1988. 1 fig, 1 tab, 99 ref.

Descriptors: *Fish, *Regulated rivers, *Regualted flow, *Fisheries, Canals, Dams, Weirs, Salmon.

The historical and recent influences of river regulation on fish pond populations and fisheries in Britain were examined. The construction of a series of canals and interconnecting waters during the 18th and 19th centuries facilitated the spread of some species between catchments. These slow-flowing habitats allowed many lowland species to thrive and this is reflected today in the fish community structure in some rivers. These problems of barriers to the movement of migratory species imposed by dams and weirs and the efficacy of compensation measures are discussed. The measures fish passes, adult fish and smolt transport, and stocking. Potential problems for the future include the disruption of the homing of salmon to their natal rivers caused by transfers of water between catchments. River basin management in Britain attempts to reconcile the water resource requirements of fisheries with those of the water users. This can be seen in the practice of Regional Water Authorities to include ameliorative measures in many of their land drainage and flood prevention designs. However, more research is required on the long-term problems and benefits of these and other river regulation schemes on resident fish populations. (Author's abstract)
W89-00960

INTERJURISDICTIONAL MANAGEMENT IN CHESAPEAKE BAY FISHERIES,
Northern Arizona Univ., Flagstaff. Dept. of Political Science.
For primary bibliographic entry see Field 6E.
W89-01073

POSSIBILITY OF USING RADIOACTIVELY POLLUTED WATERBODIES FOR FISH CULTURE,
Akademiya Nauk SSSR, Moscow. Inst. of General Genetics.
For primary bibliographic entry see Field 3C.
W89-01193

10. SCIENTIFIC AND TECHNICAL INFORMATION

10C. Secondary Publication And Distribution

CONCERNING CERTAIN STUDIES ON SEEPAGE AND DISSOLUTION OF SALTS IN THE FOUNDATION OF DAMS,
N. N. Vergin.
Hydrotechnical Construction HYCOAR, Vol. 21, No. 6, p 381-385, December 1987. 12 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 6, p

57-60, June 1987.

Descriptors: *Literature review, *Seepage, *Dam foundations, *Saline-freshwater interfaces, *Salt balance, *Leaching, Brines, Diffusivity, Errors.

For high and superhigh dams being planned and constructed in the USSR problems of seepage and dissolution of salts in their foundation are quite urgent. During the past 5-6 years about 10 studies have been published concerning these problems in collections on the hydraulic engineering of the All-Union Scientific-Research Institute of Water Supply, Sewerage, Hydraulic Structures, and Engineering Hydrogeology (VNII VODGEO). Unfortunately, many of them contain errors of a fundamental character, requiring a critical examination and appropriate revision of the main positions of the authors. As an example, several such studies were examined, and fundamental errors found. In one study of dam seepage including one or two lines of wells injecting brine and fresh water under pressure in the upper pool, the authors did not examine the main problem of the displacement of salt water by fresh and did not determine the location of the interface between them. Errors similar to those examined in this paper also exist in other articles on the study of the hydraulic engineering works of VNII VODGEO. This requires a more competent review of studies before their publication and a more thorough familiarity of members of the editorial board with the literature. (VerNooy-PTT)
W89-00062

HYDROCARBON FUEL SPILL DISPERSION ON WATER: A LITERATURE REVIEW,
Battelle Columbus Div., OH. Environmental Physics and Chemistry Section.
For primary bibliographic entry see Field 5B.
W89-00598

EROSION AND SEDIMENT YIELD RESEARCH: SOME RECENT PERSPECTIVES,
Exeter Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 2J.
W89-01015

STATUS OF ISOTOPE HYDROLOGY TODAY,
For primary bibliographic entry see Field 2A.
W89-01018

REMOTE SENSING IN HYDROLOGY,
Ruhr Univ., Bochum (Germany, F.R.). Inst. for Hydrology, Water Resources and Environmental Engineering.
For primary bibliographic entry see Field 2A.
W89-01019

METHODS AND MERITS OF REGIONAL FLOOD FREQUENCY ANALYSIS,
University Coll., Galway (Ireland). Dept. of Engineering Hydrology.
For primary bibliographic entry see Field 2E.
W89-01020

SPATIAL AND TEMPORAL SCALES IN RAINFALL ANALYSIS SOME ASPECTS AND FUTURE PERSPECTIVES,
Lund Univ. (Sweden). Dept. of Water Resources Engineering.
For primary bibliographic entry see Field 2B.
W89-01021

HYDROLOGICAL HETEROGENEITY CATCHMENT MORPHOLOGY AND CATCHMENT RESPONSE,
Lancaster Univ. (England). Centre for Research on Environmental Systems.
For primary bibliographic entry see Field 2A.
W89-01024

GROUNDWATER FLOW AND TRANSPORT MODELING,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2F.
W89-01025

SOIL PHYSICS AND HYDROLOGY,
For primary bibliographic entry see Field 2G.
W89-01026

CONTAMINANT HYDROGEOLOGY DOLLARS AND SENSE,
Alberta Univ., Edmonton. Dept. of Geology.
For primary bibliographic entry see Field 5B.
W89-01028

10D. Specialized Information Center Services

MODERN MANAGEMENT STANDARDS OF WATER NETWORK REGISTER (CRITERES MODERNES DE GESTION DU CADASTRE DES RESEAUX D'EAU),
Azienda Comunale Elettricita ed Acque, Rome (Italy).
For primary bibliographic entry see Field 5F.
W89-00919

AWWA SMALL SYSTEMS PROGRAM,
American Water Works Association, Denver, CO.
For primary bibliographic entry see Field 5F.
W89-01114

RURAL COMMUNITY ASSISTANCE PROGRAM,
Rural Community Assistance Corp., Sacramento, CA.
For primary bibliographic entry see Field 5F.
W89-01115

SUBJECT INDEX

ACCLIMATIZATION

Acclimatization of Roach, Rutilus rutilus (L.), to Toxic Components of Kraft Pulp Mill Effluents,
W89-00087 5C

ACETYLENE REDUCTION

Spatial Patterns of N Fixation (Acetylene Reduction) along Environmental Gradients in a Warm-Temperate Estuary,
W89-00475 2L

ACID LAKES

Internal Elemental Cycles Affecting the Long-Term Alkalinity Status of Lakes: Implications for Lake Restoration,
W89-00016 5G

Delayed Nutrient Responses to the Liming of Lake Gardsjon, Sweden,
W89-00441 5G

Disruption of the Nitrogen Cycle in Acidified Lakes,
W89-00451 5C

ACID MINE DRAINAGE

Effect of pH and Total Ion Concentration on Growth Rate of Chironomus nr. maturus Larvae (Diptera: Chironomidae) from an Acid Strip-Mine Lake,
W89-00399 5C

Metabolic Processes Involved in Repair of Escherichia coli Cells Damaged by Exposure to Acid Mine Water,
W89-00727 5C

ACID RAIN

Evaluation of Lake Restoration in Sweden,
W89-00021 5G

Role of External Ammonium Inputs in Freshwater Acidification,
W89-00024 5B

Chemistry of Atmospheric Precipitation in the Babia Gora National Park,
W89-00082 5B

Photosynthesis of Submersed Macrophytes in Acidified Lakes: II. Carbon Limitation and Utilization of Benthic CO2 Sources,
W89-00095 5C

Richness of Aquatic Macrophyte Floras of Soft Water Lakes of Differing pH and Trace Metal Content in Ontario, Canada,
W89-00103 5C

Ammonium and Nitrate Uptake by Aquatic Plants from Poorly Buffered and Acidified Waters,
W89-00112 5C

Effects of Acidification and Phosphorus Addition on Phytoplankton Biomass and Productivity in a Circum-Neutral Mesotrophic Lake Receiving Acid Precipitation,
W89-00179 2H

Soil Processes and Sulfate Loss at the Hubbard Brook Experimental Forest,
W89-00206 5B

Effects of Acidification on Metal Budgets of Lakes and Catchments,
W89-00207 5C

Changes in Rainwater Acidity Associated with Closure of a Copper Smelter,
W89-00272 5B

Field Study of the Cloud Chemistry and Cloud Microphysics at Great Dun Fell,
W89-00308 5B

Testing a Comprehensive Acid Deposition Model,
W89-00310 5B

Atmospheric Deposition of Arsenic and Association with Acid Precipitation,
W89-00431 5B

Short-Term Trends in Sulfate Deposition at Selected Bulk Precipitation Stations in New York,
W89-00432 5B

Comparisons of RADM and Oscar Precipitation Chemistry Data,
W89-00433 5B

Delayed Nutrient Responses to the Liming of Lake Gardsjon, Sweden,
W89-00441 5G

Depressed Mercury Levels in Biota from Acid and Metal Stressed Lakes Near Sudbury, Ontario,
W89-00442 5B

Changes in Soil Acidity in Two Forest Areas with Different Acid Deposition: 1920s to 1980s,
W89-00444 5B

Disruption of the Nitrogen Cycle in Acidified Lakes,
W89-00451 5C

Rain Acidity in Stellenbosch,
W89-00454 5A

Effects of Aquatic Humic Substances on Analysis for Hydrogen Peroxide Using Peroxidase-Catalyzed Oxidations of Triarylmethanes or p-Hydroxyphenylacetic Acid,
W89-00634 7B

Role of Chemical Weathering in the Neutralization of Acidic Deposition,
W89-00696 5B

Drainage Basin Control of Acid Loadings to Two Adirondack Lakes,
W89-00710 5B

Comparison of Robust Bayes and Classical Estimators for Regional Lake Models of Fish Response to Acidification,
W89-00713 5C

Alkalinity Regulation in Softwater Florida Lakes,
W89-00714 2H

Stream Chemistry in the New Jersey Pinelands: The Influence of Precipitation and Watershed Disturbance,
W89-00716 5B

Predicting Regional Episodic Acidification of Surface Waters Using Empirical Models,
W89-00719 5B

Evaluation of the Sulfur(IV) Catalyzed Autoxidation of Cobalt(II) in an Azide Containing Medium as a Means for the Determination of Sulfite in Precipitation,
W89-00736 5A

Other Forms of Environmental Pollution,
W89-00794 5B

Clean Air Act-Transboundary Acid Rain Pollution Abatement-Administrative Discretion Citizen Suit,
W89-00839 5G

Effects of Sulphur Deposition on Lake-Water Chemistry in Ontario, Canada,
W89-00846 5B

Differences in the Spectral Characteristics of Birch Canopies Exposed to Simulated Acid Rain,
W89-00849 5C

Acidification of Shallow Groundwaters During the Spring Melt Period,
W89-00893 5B

Modelling the Effects of Acid Deposition: Estimation of Long-Term Water Quality Responses in Forested Catchments in Finland,
W89-00894 5B

Assessing the Birkenes Model of Stream Acidification Using a Multisignal Calibration Methodology,
W89-00974 7B

Effects of a Simulated Acid Precipitation on Leaf Litter Quality and the Growth of a Detritivore in a Buffered Lotic System,
W89-01058 5C

Accumulation of Polycyclic Aromatic Hydrocarbons in Acid Sensitive Lakes,
W89-01074 5B

Effects of Acute Exposure to Acidified Water on the Behavorial Response of Fathead Minnows, Pimephales Promelas, to Alarm Substance (Schreckstoff),
W89-01092 5C

Influence of Altitude on Rainfall Composition at Great Dun Fell,
W89-01146 5B

Influence of Altitude on Wet Deposition: Comparison between Field Measurements at Great Dun Fell and the Predictions of a Seeder-Feeder Model,
W89-01147 5B

Aerosol and Hydrometeor Concentrations and Their Chemical Composition during Winter Precipitation along a Mountain Slope: I. Temporal Evolution of the Aerosol, Microphysical and Meteorological Conditions,
W89-01150 2B

Acidic Deposition Distribution and Episode Statistics from the MAP3S Network Database,
W89-01151 5B

Wet-Only Precipitation Study in a Mediterranean Site, Patras, Greece,
W89-01152 2B

Effects of Simulated Acidic Precipitation on Plant-Insect Interactions in Agricultural Systems: Corn and Black Cutworm Larvae,
W89-01160 5C

Hydrogen Ion Concentration and Alkalinity of Reservoir Water in the Sierra Nevada, California, and Correlations with Air Pollutants,
W89-01165 5B

Effects of Leaching and Whole-Tree Harvesting on Cation Budgets of Several Forests,
W89-01166 4C

Annual Elemental Input/Output Estimates for Two Forested Watersheds in Eastern Tennessee,
W89-01168 5B

Stream Acidification Trends in the Welsh Uplands: A Modelling Study of the Llyn Brianne Catchments,
W89-01206 5C

Relationship Between Glacial Geology and Streamwater Chemistry in an Area Receiving Acid Deposition,
W89-01210 5B

Relative Roles of Emissions Changes and Meteorological Variability of Wet sulfur Deposition: A Trajectory Model Study,
W89-01259 5B

Winter Cloud Water and Air Composition in Central Ontario,
W89-01265 5C

ACID RAIN EFFECTS
Growth Strategies and Distribution of Isoetids in Scottish Freshwater Lochs,
W89-00129 5C

Effects of Acidification on Mercury Methylation, Demethylation, and Volatilization in Sediments from an Acid-Susceptible Lake,
W89-00731 5B

Multisignal Automatic Calibration Methodology for Hydrochemical Models: A Case Study of the Birkenes Model,
W89-00973 5B

Potential Importance of Spatial and Temporal Heterogeneity in pH, Al, and Ca in Allowing Survival of a Fish Population: A Model Demonstration,
W89-01052 5C

Aluminum Speciation in Surface Waters from a Welsh Upland Area,
W89-01055 5B

Effects of a Simulated Acid Precipitation on Leaf Litter Quality and the Growth of a Detritivore in a Buffered Lotic System,
W89-01058 5C

Comparative Sensitivities of Bluegill, Channel Catfish and Fathead Minnow to pH and Aluminum,
W89-01098 5C

ACID STREAMS
Effect of Low pH on Survival of Brook Trout Embryos and Yolk-Sac Larvae in West Virginia Streams,
W89-00293 5C

Assessing the Birkenes Model of Stream Acidification Using a Multisignal Calibration Methodology,
W89-00974 7B

Stream Acidification Trends in the Welsh Uplands: A Modelling Study of the Llyn Brianne Catchments,
W89-01206 5C

ACIDIC WATER
Evaluation of Lake Restoration in Sweden,
W89-00021 5G

Effects of Acidification on Metal Budgets of Lakes and Catchments,
W89-00207 5C

Cycling of Inorganic and Organic Sulfur in Peat from Big Run Bog, West Virginia,
W89-00208 2H

Changes in Rainwater Acidity Associated with Closure of a Copper Smelter,
W89-00272 5B

Does pH Affect Fish Species Richness when Lake Area is Considered,
W89-00324 2H

Comparison of Robust Bayes and Classical Estimators for Regional Lake Models of Fish Response to Acidification,
W89-00713 5C

Predicting Regional Episodic Acidification of Surface Waters Using Empirical Models,
W89-00719 5B

Effects of Acidification on Mercury Methylation, Demethylation, and Volatilization in Sediments from an Acid-Susceptible Lake,
W89-00731 5B

ACIDIC WATERS
Patterns of Epipelic Algal Distribution in an Acidic Adirondack Lake,
W89-00298 2H

ACIDIFICATION
Role of External Ammonium Inputs in Freshwater Acidification,
W89-00024 5B

Effect of Drainage Basin on Heavy Metal Concentrations in Stream Waters in the Niepolomice Forest,
W89-00260 5B

Effect of Low pH on Survival of Brook Trout Embryos and Yolk-Sac Larvae in West Virginia Streams,
W89-00293 5C

ACIDITY
Internal Elemental Cycles Affecting the Long-Term Alkalinity Status of Lakes: Implications for Lake Restoration,
W89-00016 5G

Effect of pH and Contact Time on the Concentration of As(III) and As(V) in Coal Ash Systems,
W89-00624 5E

Manganese Oxidation in pH and O2 Microenvironments Produced by Phytoplankton,
W89-01045 2K

ACTIVATED CARBON
Fate of Alachlor during Treatment of Public Water Supplies,
W89-00395 5F

GAC Treatment Cost Experience at Two Drinking Water Utilities,
W89-00495 5F

Determination of Total Organic Chlorine and Bromine in Water Samples by Adsorption onto Activated Carbon and Neutron Activation Analysis,
W89-00588 5A

Application of Biologically Activated Sorptive Columns for Textile Waste Water Treatment,
W89-00632 5D

Adsorption of Indigo Carmine by Activated Carbon,
W89-00633 5D

Sequential Wet Air Regeneration of PAC from the Powdered Carbon-Activated Sludge Process,
W89-01137 5D

ACTIVATED SLUDGE
Isolation, Identification and Characterisation of Filamentous and Floc-Forming Bacteria from Activated Sludge Flocs,
W89-00648 5D

Effect of Environmental Conditions on the Occurrence of Microthrix parvicella in Activated Sludge,
W89-01217 5D

Activated Sludge Systems with Biomass Particle Support Structures,
W89-01256 5D

ACTIVATED SLUDGE PROCESS
Removal of Pentachlorophenol in Municipal Activated Sludge Systems,
W89-00509 5D

Treatability Studies of Textile Wastewater,
W89-00627 5D

Bulking Control with Ozonation in a Nutrient Removal Activated Sludge System,
W89-00930 5D

In situ Adapation of Activated Sludge by Shock Loading to Enhance Treatment of High Ammonia Content Petrochemical Wastewater,
W89-01127 5D

Removal of Organic Toxic Pollutants by Trickling Filter and Activated Sludge,
W89-01133 5D

MCRT for Control of Cokemaking Wastewater treatment,
W89-01139 5D

ADAPTATION
Adaptation of Phytoplankton-Degrading Microbial Communities to Thermal Reactor Effluent in a New Cooling Reservoir,
W89-00336 5C

Induced Resistance to Polychlorinated Biphenyls Confers Cross-Resistance and Altered Environmental Fitness in a Marine Diatom,
W89-00860 5C

Population Genetics of Mytilus edulis (L.) from Oslofjorden, Norway in Oil-Polluted and Non Oil-Polluted Water,
W89-01009 5C

ADMINISTRATIVE AGENCIES
Regulation of Pollution: Controls and Responsibilities,
W89-00786 6E

ADRIATIC SEA
Principal Component Analysis of Precipitation in the Adriatic-Pannonian Area of Yugoslavia,
W89-00472 2B

ADSORPTION
Multi-Component Sorption Isotherms of Basic Dyes onto Peat,
W89-00083 5D

Novel Approach for Modifying Microporous Filters for Virus Concentration from Water,
W89-00332 5A

Removal of Chrome Dye from Carpet Effluents Using Coal: I,
W89-00630 5D

Adsorption of Indigo Carmine by Activated Carbon,
W89-00633 5D

Characterization of the Interaction Between Viruses and a Solid Polymeric Contact Disinfectant,
W89-00884 5F

Theoretical Analysis of Deviations from Local Equilibrium During Sorbing Solute Transport Through Idealized Stratified Aquifers,
W89-00987 5B

Sorption of Cationic Oligomers on Sediments,
W89-01094 5B

Evaluating Various Adsorbents and Membranes for Removing Radium from Groundwater,
W89-01109 5F

Gravimetric Measurement of Adsorption Parameters in Water Systems with a Quartz Spring Balance,
W89-01216 5A

Effects of Cyanide and Polyphosphates on Adsorption of Metals from Simulated and Real Mixed-Metal Plating Wastes,
W89-01219 5D

Binding of Heavy Metals to Algal Surfaces,
W89-01227 5B

Metallothionein-Like Heavy Metal Binding Protein Levels in Asiatic Clams Are Dependent on

the Duration and Mode of Exposure to Cadmium,
W89-01228 5B

ADVECTION
Dynamical Structure of Vertically Two-Dimensional Estuary in Steady State,
W89-00680 2L

Large-Scale and Long-Term Variations in the Zooplankton Community of the Gullmar Fjord, Sweden, in Relation to Advective Processes,
W89-01038 2L

AEOLIAN DEPOSITS
Stokes Surfaces and the Effects of Near-Surface Groundwater-Table on Aeolian Deposition,
W89-00410 2J

AERATION
Lake Restoration: Why Oxygenation and Artificial Mixing Cannot Substitute for a Decrease in the External Phosphorus Loading,
W89-00015 5G

Fine Bubble Aeration: Considerations in Design and Operation,
W89-01101 5D

AERATION ZONE
Modelling Soil Water Dynamics in the Unsaturated Zone: State of the Art,
W89-01014 2G

Tracing of Water Movement in the Unsaturated Zone Using Stable Isotopes of Hydrogen and Oxygen,
W89-01016 2G

AERIAL PHOTOGRAPHY
Barrier/Estuarine Processes. Bot River Estuary: An Interpretation of Aerial Photographs,
W89-00650 2L

AEROBIC CONDITIONS
Aerobic Biodegradation of Natural and Xenobiotic Organic Compounds By Subsurface Microbial Communities,
W89-01090 5B

AEROBIC TREATMENT
Operation of a Three-Phase Biofilm Fluidized Sand Bed Reactor for Aerobic Wastewater Treatment,
W89-00747 5D

AEROSOLS
Rain-Aerosol Coupling in Urban Area: Scavenging Ratio Measurement and Identification of Some Transfer Processes,
W89-00430 2B

Aerosol and Hydrometeor Concentrations and Their Chemical Composition during Winter Precipitation along a Mountain Slope: I. Temporal Evolution of the Aerosol, Microphysical and Meteorological Conditions,
W89-01150 2B

Aspects of Atmospheric Pollutant Origin and Deposition Revealed by Multielemental Observations at a Rural Location in Eastern Canada,
W89-01264 5B

AFRICA
Networking Urban Water Supplies in West Africa,
W89-00419 5F

Sedimentary Environments and Facies of the Subtropical Mgeni Estuary, Southeast Africa,
W89-01084 2L

AGRICULTURAL CHEMICALS
Properties of Water Treatment Lime Sludges and Their Effectiveness as Agricultural Limestone Substitutes,
W89-00516 5F

Problem with Nitrates,
W89-00965 5B

AGRICULTURAL HYDROLOGY
Water Management for Lowland Rice Irrigation,
W89-00750 3F

AGRICULTURAL RUNOFF
Factors Forming the Level and Dynamics of Nutrient Runoff from an Agricultural Watershed,
W89-00261 5B

Runoff Generation in a Plough-drained Peat Bog in Southern Scotland,
W89-00345 4C

Regional Hydrogeology of Agricultural Drainage Wells in Iowa,
W89-00471 5B

Modified Fickian Model for Solute Uptake by Runoff,
W89-00486 5B

AGRICULTURAL WATERSHEDS
Spatial and Temporal Variability of the Index of Biotic Integrity in Three Midwestern Streams,
W89-00026 2E

AIR POLLUTION
Role of External Ammonium Inputs in Freshwater Acidification,
W89-00024 5B

Use of Mires in Monitoring the Atmospheric Deposition of Heavy Metals,
W89-00123 5A

Aliphatic and Polycyclic Aromatic Hydrocarbons in Urban Rain, Snow and Fog,
W89-00309 5B

Rain-Aerosol Coupling in Urban Area: Scavenging Ratio Measurement and Identification of Some Transfer Processes,
W89-00430 2B

Head-Space Analysis of Readily Volatile Chlorinated Hydrocarbons in Air and Water (Head-Space-Analytik Leichtfluechtiger Chlorkohlenwasserstoffe in Luft und Wasser),
W89-00504 5A

Analysis of Halogenated Polycyclic Aromatic Hydrocarbons in Urban Air, Snow and Automobile Exhaust,
W89-00613 5B

Field Measurements of Water-Air Exchange of Mercury in Freshwater Systems,
W89-00640 5A

Wet Deposition of Ammonium in Europe,
W89-00765 2B

Dissolution of Trace Metals from Particles of Industrial Origin and Its Influence on the Composition of Rainwater,
W89-01149 5B

Aerosol and Hydrometeor Concentrations and Their Chemical Composition during Winter Precipitation along a Mountain Slope: I. Temporal Evolution of the Aerosol, Microphysical and Meteorological Conditions,
W89-01150 2B

Atmospheric Deposition of Polycyclic Aromatic Hydrocarbons to Water Surfaces: A Mass Balance Approach,
W89-01257 5B

Aspects of Atmospheric Pollutant Origin and Deposition Revealed by Multielemental Observations at a Rural Location in Eastern Canada,
W89-01264 5B

AIR POLLUTION EFFECTS
Influence of Dusts from Chosen Industrial Plants on Particular Links of Forest Ecosystem of the Niepolomice Forest,
W89-00081 5C

Other Forms of Environmental Pollution,
W89-00794 5B

Effects of Sulphur Deposition on Lake-Water Chemistry in Ontario, Canada,
W89-00846 5B

Differences in the Spectral Characteristics of Birch Canopies Exposed to Simulated Acid Rain,
W89-00849 5C

Effects of Simulated Acidic Precipitation on Plant-Insect Interactions in Agricultural Systems: Corn and Black Cutworm Larvae,
W89-01160 5C

Hydrogen Ion Concentration and Alkalinity of Reservoir Water in the Sierra Nevada, California, and Correlations with Air Pollutants,
W89-01165 5B

AIR POLLUTION SOURCES
Emissions of Chlorinated Organics from a Municipal Sewage Sludge Burning Incinerator,
W89-00607 5B

AIR-WATER INTERFACES
Air and Water Flow: I. Horizontal Flow with an Arbitrary Flux Boundary Condition,
W89-00347 2G

Air and Water Flow: II. Gravitational Flow with an Arbitrary Flux Boundary Condition,
W89-00348 2G

Influence of an Arctic Large-Lakes System on Mesoclimate in South-Central Baffin Island, N.W.T., Canada,
W89-00437 2H

Sea-Surface Microlayer of Puget Sound: Part I: Toxic Effects on Fish Eggs and Larvae,
W89-00853 5C

Sea-Surface Microlayer of Puget Sound: Part II: Concentrations of Contaminants and Relation to Toxicity,
W89-00854 5C

Toxicity of Sea-Surface Microlayer: Effects On Herring and Turbot Embryos,
W89-00855 5C

Toxicity of Sea-Surface Microlayer: Effects of Hexane Extract on Baltic Herring (Clupea harengus) and Atlantic Cod (Gadus morhua) Embryos,
W89-00856 5C

Contaminant Concentrations and Toxicity of Sea-Surface Microlayer Near Los Angeles, California,
W89-00857 5C

Laboratory Study of the Accumulation and Toxicity of Contaminants at the Sea Surface from Sediments Proposed for Dredging,
W89-00858 5E

AIRCRAFT
Comparison of High-Altitude Remote Aircraft Measurements with the Radar Structure of an Oklahoma Thunderstorm: Implications for Precipitation Estimation from Space,
W89-00844 7B

AL-HADITHAH HYDRO DEVELOPMENT
Characteristics of the Organization and Performance of Works in the Dam Foundation of the Al-Hadithah Hydro Development (Iraq),
W89-01182 8F

ALACHLOR
Fate of Alachlor during Treatment of Public Water Supplies,
W89-00395 5F

ALASKA
Productivity and Nutrient Cycling of Alaskan Tundra: Enhancement by Flowing Soil Water,
W89-00908 2G

ALDICARB
Sorption and Degradation of Aldicarb and Its Oxidation Products in a Soil-Water Flow System as a Function of pH and Temperature,
W89-01164 5B

ALGAE
Hypolimnetic Chlorophyll Maximum by Algae and Sulphur Bacteria in one Eutrophic Pond,
W89-00012 2H

Response of Phytoplankton Communities to Changing Lake Environments,
W89-00018 2H

Seasonal Productivity Cycle of Phytoplankton and Controlling Factors in Lake Constance,
W89-00022 2H

Development of Microorganisms on the Background of Organic Matter in Forest Ecosystem Waters,
W89-00080 2H

Seasonal Abundance and Distribution of Drift Algae and Seagrasses in the Mid-Indian River Lagoon, Florida,
W89-00104 2L

Seasonal Changes of Phytoplankton in the Backwater Bokros,
W89-00147 2H

Role of Sewage Effluent in the Accumulation of Macroalgal Mats on Intertidal Mudflats in Two Basins in Southern England,
W89-00159 5C

Seasonal Fluctuations in the Species Composition of Phytoplankton and Phytobenthos in the Lobau Near Vienna (Jahreszeitliche Schwankungen in der Zusammensetzung des Phytoplanktons und Phytobenthos in Altwassern der Lobau bei Wien),
W89-00166 2H

Impact of Impounding on the Oxygen Balance of the Danube from Kelheim to Jochenstein Microbiological-Biochemical Investigations and Water Quality Model Calculations (Zum Einfluss der Strauregulierung auf den Sauerstoffhaushalt der Donaustrecke Kelheim-Jochenstein: Mikrobiologisch-biochemische Untersuchungen und Gutemodellrechnungen),
W89-00173 6G

Quantum Yield as a Fundamental Parameter Controlling Vertical Photosynthetic Profiles of Phytoplankton in Lake Constance,
W89-00176 2H

Diatoms and Other Algae from the Thermal-Sulphur Springs of Triponzo (Central Italy),
W89-00190 2H

Bromothymol-Blue Test: A Simple Algal Bioassay and its Use for Herbicide Screening,
W89-00192 5A

Could Benthic Algae be used as Water Quality Indicators (Konnen Benthische Algen zur Wassergute-Bestimmung Herangezogen Werden),
W89-00194 5A

Changes in Phytoplankton Over a Ten-Year Period in a Lake Undergoing De-Eutrophication due to Surrounding Peat Bogs,
W89-00196 2H

Measurement of Primary Productivity in a High-Rate Oxidation Pond (HROP),
W89-00213 2H

Species Diversity of Algal Flora in Vishwamitri River, Baroda (India),
W89-00234 2H

Nutrient and Light Limitation of Algae in Two Northern California Streams,
W89-00296 2H

Patterns of Epipelic Algal Distribution in an Acidic Adirondack Lake,
W89-00298 2H

Phagotrophic Phototrophs: The Ecological Significance of Mixotrophy,
W89-00384 2H

Binding and Removal of Aluminum Ions in Waters by an Algal Biomass.
W89-00478 5F

Algal Studies of the River Ely, South Wales, U.K.: I. Phytoplankton,
W89-00678 2H

Algal Studies of the River Ely, South Wales, U.K.: II. Epilithic Algae,
W89-00679 2H

Diurnal Changes of pH Distribution and the Cascading of Shore Water in a Sargassum Forest,
W89-00682 2L

Impact of a Municipal Wastewater Effluent on Water Quality, Periphyton, and Invertebrates in the Little Miami River Near Xenia, Ohio,
W89-00685 5C

Effects of Current Velocity on the Physical Structuring of Diatom (Bacillariophyceae) Communities,
W89-00686 2E

Attached Algae of the Clyde and Garnock Estuaries,
W89-00807 5C

Ecology of Macroalgae in the Firth of Clyde,
W89-00815 2L

Seaweed-Associated Animal Communities in the Firth of Clyde, with Special Reference to the Population Biology of the Amphipod Hyale nilssoni (Rathke),
W89-00816 2L

Effects of Light and Temperature on Photosynthesis of the Nuisance Alga Cladophora glomerata (L.) Kutz from Green Bay, Lake Michigan,
W89-00848 2H

K-Systems Analysis for Determining the Factors Influencing Benthic Microfloral Productivity in a Louisiana Estuary, USA,
W89-01035 2L

Influence of Microphytobenthos on the Nutrient Flux between Sediment and Water: A Laboratory Study,
W89-01036 2L

Discrimination between Algae and Artificial Particles by Freshwater and Marine Copepods,
W89-01047 2H

Myxococcal Predation on Cyanobacterial Populations: Nutrient Effects,
W89-01050 2H

Use of Duckweed for Wastewater Treatment,
W89-01128 5D

Microcomputer-Based Measurement of Algal Fluorescence as a Potential Indicator of Environmental Contamination,
W89-01157 5A

Release of Micro-algal Photosynthate and Associated Bacterial Uptake and Heterotrophic Growth,
W89-01187 2H

Modeling Blue-Green Algal Blooms in the Lower Neuse River,
W89-01225 5C

Binding of Heavy Metals to Algal Surfaces,
W89-01227 5B

Assessment of Selenium Toxicity in Algae Using Turbidostat Culture,
W89-01230 5C

ALGAL GROWTH
Availability of Phosphorus Sources for Blooms of Phaeocystis pouchetii (Haptophyceae) in the North Sea: Impact of the River Rhine,
W89-00004 2L

Effect of 3,4 Benzopyrene on the Photosynthetic and Respiratory Intensity of the Green Alga Scenedesmus quadricauda (Der Einfluss von 3,4-Benzpyren aud die Photosynthese- une Respirationsintensitat der Gruenalge Scenedesmus quadricauda),
W89-00135 5C

Animal Wastes Media for Spirulina Production,
W89-00136 5D

Release of Micro-algal Photosynthate and Associated Bacterial Uptake and Heterotrophic Growth,
W89-01187 2H

ALGAL MATS
Physiological Ecology of Bluegreen Algal Mats (Modern Stromatolites) in Antarctic Oasis Lakes,
W89-00185 2H

ALKALINITY
Internal Elemental Cycles Affecting the Long-Term Alkalinity Status of Lakes: Implications for Lake Restoration,
W89-00016 5G

Alkalinity Regulation in Softwater Florida Lakes,
W89-00714 2H

Phosphorus Removal by Crystallization Using a Granular Activated Magnesia Clinker,
W89-01126 5D

Hydrogen Ion Concentration and Alkalinity of Reservoir Water in the Sierra Nevada, California, and Correlations with Air Pollutants,
W89-01165 5B

ALKYL-LEAD CHLORIDES
Toxicity of Alkyllead Salts to Anaerobic Nitrogen Transformations in Sediment,
W89-01167 5C

ALKYLBENZENE SULFONATES
Seasonal and Temporal Changes of Organic Compounds in Rain and Snow,
W89-00429 5B

ALLUVIAL CHANNELS
Friction Factor Evaluation in Gravel-Bed Rivers,
W89-00898 8B

Alluvial Channel Hydraulics,
W89-01017 2J

ALPAR BACKWATER
Water Quality of the Tisza River and the Alpar Backwater,
W89-00143 5B

ALPINE REGIONS
Structure of Macrobenthic Biomass in the Gravel Bed of the Pre-Alpine Loisach River (Die Struktur der makrobenthischen Biomasse in einem voralpinen Schotterbett am Beispiel der mittleren Loisach),
W89-00167 2H

ALTERNATIVE DRILLING
O and M Spending Levels in Third World Irrigation Systems: Exploring Economic Alternatives,
W89-00874 3F

ALTERNATIVE PLANNING
Alternative Strategies for Stormwater Detention,
W89-00875 4A

ALTITUDE
Influence of Altitude on Rainfall Composition at Great Dun Fell,
W89-01146 5B

Influence of Altitude on Wet Deposition: Comparison between Field Measurements at Great Dun Fell and the Predictions of a Seeder-Feeder Model,
W89-01147 5B

ALUM
Lake Treatment with Alum,
W89-00745 5G

ALUMINUM
Binding and Removal of Aluminum Ions in Waters by an Algal Biomass.
W89-00478 5F

Potential Importance of Spatial and Temporal Heterogeneity in pH, Al, and Ca in Allowing Survival of a Fish Population: A Model Demonstration,
W89-01052 5C

Aluminum Speciation in Surface Waters from a Welsh Upland Area,
W89-01055 5B

Comparative Sensitivities of Bluegill, Channel Catfish and Fathead Minnow to pH and Aluminum,
W89-01098 5C

Assessing Effects of Soil Pollution Control Residuals on Soil Chemistry Properties,
W89-01140 5E

ALUMINUM SULFATE
Growth Kinetics of Hydroxide Flocs,
W89-00428 5F

Lake Treatment with Alum,
W89-00745 5G

Factors Affecting Coagulation with Aluminum Sulfate: I. Particle Formation and Growth,
W89-01221 5F

Factors Affecting Coagulation with Aluminum Sulfate: II. Dissolved Organic Matter Removal,
W89-01222 5F

AMAZON
Mercury Inputs into the Amazon Region, Brazil,
W89-00637 5B

AMAZON RIVER
Nitrate and Ammonium Uptake by Plankton in an Amazon River Floodplain Lake,
W89-00229 2H

Water Resources, Salinity and Salt Yields of the Rivers of the Bolivian Amazon,
W89-01213 2E

AMMONIA
Nitrite and Ammonia in the Tamar Estuary,
W89-00154 5B

Comparison of Nutrients in the Interstitial Water of Reducing (Tamar Estuary) and Oxic (Carmarthen Bay) Coastal Sediments,
W89-00156 2L

Acute Toxicity of Ammonia to Common Carp (Cyprinus carpio L.),
W89-00244 5C

Influence of pH and Ammonia Salts on Ammonia Toxicity and Water Balance in Young Channel Catfish,
W89-00377 5C

Ammonia Nitrogen Removal in Attached-Growth Ponds,
W89-00489 5D

AMMONIUM
Role of External Ammonium Inputs in Freshwater Acidification,
W89-00024 5B

Ammonium and Nitrate Uptake by Aquatic Plants from Poorly Buffered and Acidified Waters,
W89-00112 5C

Regeneration and Uptake of Ammonium by Plankton in an Amazon Floodplain Lake,
W89-00230 2H

Wet Deposition of Ammonium in Europe,
W89-00765 2B

AMPHIBIANS
Toxicity of an Anionic Detergent to the Spawn and Larvae of Anurans (Amphibia),
W89-00139 5C

AMPHIPODS
Seaweed-Associated Animal Communities in the Firth of Clyde, with Special Reference to the Population Biology of the Amphipod Hyale nilssoni (Rathke),
W89-00816 2L

ANAEROBIC BACTERIA
Development of Mass Blooms of Photosynthetic Bacteria on Sheltered Beaches in Scapa Flow, Orkney Islands,
W89-00795 2L

ANAEROBIC CONDITIONS
Qualitative and Quantitative Changes in Phytoplankton on the Background of Physicochemical Changes in the Water of Swietokrzyskie Lake in the Years 1977-1979,
W89-00258 5C

Snail Distributions in Lake Erie: The Influence of Anoxia in the Southern Central Basin Nearshore Zone,
W89-00683 2A

Provisional Diagenetic Model for pH in Anoxic Porewaters: Application to the FOAM Site,
W89-00767 2J

Dissolved Organic Carbon and Manganese in the Boundary of the Oxic and Anoxic Layers in Lakes Fukami-ike and Suigetsu-ko,
W89-00771 2H

Studies on Formations and Changes of Micro-Stratification in Blackish Water Lake Shinji, (in Japanese),
W89-00772 2H

ANAEROBIC DIGESTION
Cotton Yarn and Fabric Finishing Wastewater Treatment in Upflow Anaerobic Filter,
W89-00277 5D

Influence of Feeding Procedure on Microbial Reductions and Performance of Anaerobic Digestion,
W89-00511 5D

Effect of Sulphide on the Anaerobic Degradation of Propionate,
W89-00625 5D

Effects of Biofilter Media on the Performance of Anaerobic Hybrid Reactors,
W89-00626 5D

Assessment of the Toxicity of Heavy Metals to the Anaerobic Digestion of Sewage Sludge,
W89-00631 5D

Comparison of Co-Digestion Performance of Two Differently Collected Organic Fractions of Municipal Solid Waste with Sewage Sludges,
W89-00643 5D

Kinetics and Reaction Engineering of Anaerobic Sewage Treatment (Kinetik und Reaktionstechnik der anaeroben Abwasserreinigung),
W89-01185 5D

Anaerobic Treatment of Leachate Using Fixed Film and Sludge Bed Systems,
W89-01238 5D

ANALYTICAL METHODS
Determination of Hydrophilic Thiols in Sediment Porewater Using Ion-Pair Liquid Chromatography Coupled to Electrochemical Detection,
W89-00266 7B

Isotope Ratio Measurements of Mo, V, Ti, and Zr and the Determination of These Elements in Water Samples with a Thermal Ionization Quadrupole Mass Spectrometer (Isotopenverhaltnismessung von Mo, V, Ti and Zr Sowie Deren Konzentrationsbestimmung in Wassern Mit Einem Thermionen-Quadrupol-Massenspektrometer),
W89-00267 5A

Chromium Trace Determination in Inorganic, Organic and Aqueous Samples with Isotope Dilution Mass Spectrometry (Chromspurenbestimmungen in Anorganischen, Organischen und wa-Brigen Proben mit der Massenspektrometrischen Isotopenverdunnungsanalyse),
W89-00268 5A

Determination of Nitrate at the Ng/g Level in Antarctic Snow Samples with Ion Chromatography and Isotope Dilution Mass Spectrometry,
W89-00269 5A

Determination of Heavy Metals at the Pg/g Level in Antarctic Snow with DPASV and IDMS,
W89-00270 5A

Efficacy of Chemical Dosing Methods for Isolating Nontuberculous Mycobacteria from Water Supplies of Dialysis Centers,
W89-00343 5A

ANILINES
Reactivity of the Carbonate Radical with Aniline Derivatives,
W89-01088 5B

ANIMAL BEHAVIOR
Feeding and Swimming Behavior in Grazing Microzooplankton,
W89-00382 2H

Discrimination between Algae and Artificial Particles by Freshwater and Marine Copepods,
W89-01047 2H

ANIMAL BEHAVIORS
Homing of Adult Chinook Salmon after Brief Exposure to Whole and Dispersed Crude Oil,
W89-00375 5C

ANIMAL METABOLISM
Uptake and Distribution of Copper Sulphate and Its Effect on the Respiration Rate of the Hemocyanin-Producing Freshwater Snail Lymnaea natalensis,
W89-01155 5G

ANIMAL PATHOLOGY
Branchial and Renal Pathology in the Fish Exposed Chronically to Methoxy Ethyl Mercuric Chloride,
W89-01156 5C

ANIMAL WASTES
Animal Wastes Media for Spirulina Production,
W89-00136 5D

ANIONS
Determination of Mono- and Divalent Cations and Anions in Small Fog Samples by Ion Chromatography,
W89-00372 5A

ANISOTROPY
Tracer Test Analysis of Anisotropy in Hydraulic Conductivity of Granular Aquifers,
W89-00940 2F

Time-Dependent Macrodispersion for Solute Transport in Anisotropic Heterogeneous Aquifers,
W89-01245 2F

ANNUAL VARIATION
El Nino-Southern Oscillation and Rainfall Variability,
W89-00276 2B

ANODIC STRIPPING VOLTAMMETRY
Sediment Analysis: Lability of Selectively Extracted Fractions,
W89-00744 5A

ANOXIA
Snail Distributions in Lake Erie: The Influence of Anoxia in the Southern Central Basin Nearshore Zone,
W89-00683 2A

ANTARCTIC
Physiological Ecology of Bluegreen Algal Mats (Modern Stromatolites) in Antarctic Oasis Lakes,
W89-00185 2H

ANTARCTICA
Determination of Nitrate at the Ng/g Level in Antarctic Snow Samples with Ion Chromatography and Isotope Dilution Mass Spectrometry,
W89-00269 5A

Determination of Heavy Metals at the Pg/g Level in Antarctic Snow with DPASV and IDMS,
W89-00270 5A

Nitrate Trace Determinations in Snow and Firn Core Samples of Ice Shelves at the Weddell Sea, Antarctica,
W89-01258 5B

APPROXIMATION METHOD
Air and Water Flow: II. Gravitational Flow with an Arbitrary Flux Boundary Condition,
W89-00348 2G

New Approximate Technique for the Hodograph Method in Groundwater Flow and Its Application to Coastal Aquifers,
W89-01243 2F

AQUACULTURE
Primary Production in Lakes with Cage Trout Culture,
W89-00238 2H

Sorption of Cations by Bottom Sediments of Szczytno Male and Letowo Lakes, with Cage Trout Culture,
W89-00239 2H

Nitrogen and Phosphorus Balance in Lake Szczytno Male,
W89-00240 2H

Hydrochemical Study of Lake Szczytno Male With Trout Cage Culture,
W89-00241 5B

Testing the Secondary Treatment of Effluents from the 'Police' Chemical Plant in Carp Ponds,
W89-00255 5D

Chlorophyll Relationships in Letowo and Szczytno Male Lakes, with Trout Cage Culture,
W89-00262 2H

Effects of Polyculture and Manure Fertilization on Water Quality and Heterotrophic Productivity in Macrobrachium rosenbergii Ponds,
W89-00327 8I

AQUATIC ANIMALS
Depressed Mercury Levels in Biota from Acid and Metal Stressed Lakes Near Sudbury, Ontario,
W89-00442 5B

Ecological and Saprobiological Status of the Rhine (Der Oekologisch-Saprobiologische Zustand des Rheins),
W89-00498 2H

Variations in the Use of the Bot River Estuary by Water-Birds,
W89-00661 2L

Dynamics of Hydra Populations in Lake Zurich, Switzerland, and Lake Maggiore, Italy,
W89-00692 2H

Eutrophication and Benthic Fauna of Three Mountain Lakes (Eutrophisation et Faune Benthique de Trois Lacs de Montagne),
W89-00695 5C

Seaweed-Associated Animal Communities in the Firth of Clyde, with Special Reference to the Population Biology of the Amphipod Hyale nilssoni (Rathke),
W89-00816 2L

Some Biological Aspects of Liza abu (Heckel) mugilidae, in AL-Daoodi Drain, (Baghdad, Iraq),
W89-00890 2H

Results of Ecological Monitoring of Three Beaches Polluted by the 'Amoco Cadiz' Oil Spill: Development of Meiofauna from 1978 to 1984,
W89-01031 5C

Volume Fraction Correlation for Narcosis in Aquatic Organisms: The Key Role of Partitioning,
W89-01096 5C

Sensitivity of Freshwater Pulmonate Snails, Lymnaea luteola L., to Heavy Metals,
W89-01154 5C

AQUATIC BACTERIA
Loss Processes Influencing Growth of Planktonic Bacterial Populations in Lake Constance,
W89-00217 2H

Bacterial Response to Seasonal Changes in Primary Production and Phytoplankton Biomass in Lake Constance,
W89-00225 2H

Populations of Anaerobic Phototrophic Bacteria in a Spartina alterniflora Salt Marsh,
W89-00333 2L

Contribution of Plasmids to Naphthalene Catabolism in Sediment Bacteria,
W89-00378 5B

Distribution of Chitinolytic Bacteria in Various Aquatic Systems: A Comparative Study,
W89-00402 2H

Effect of Salinity and Temperature Variations on the Bacterial Population in the Bot River Estuary,
W89-00657 2L

Degradation and Formation of Refractory DOM by Bacteria During Simultaneous Growth on Labile Substrates and Persistent Lake Water Constituents,
W89-00691 2H

Bacterial Production in Fresh and Saltwater Ecosystems: A Cross-System Overview,
W89-01034 2H

AQUATIC DRIFT
Drift of Zooplankton in a Lake-Outlet (Glatt) in a Day-Night-Rhythm Depending from the Water Level,
W89-00025 2H

Effects of Season and Substrate on Availability of Drift for Fish in a Small Warmwater Stream,
W89-00400 2H

AQUATIC ENVIRONMENT
Evaluation of the 'Fugacity' (FEQUM) and the 'EXAMS' Chemical Fate and Transport Models: A Case Study on the Pollution of the Norrsundet Bay (Sweden),
W89-00357 5B

Distribution of Chitinolytic Bacteria in Various Aquatic Systems: A Comparative Study,
W89-00402 2H

Ca(+2)-Stress, Biological Response and Particle Aggregation in the Aquatic Habitat,
W89-00669 2K

Bacterial Production in Fresh and Saltwater Ecosystems: A Cross-System Overview,
W89-01034 2H

AQUATIC HABITATS
Distribution, Dynamics and Productivity of a Colonizing (Polydora quadrilobata) and an Established (P. ligni) Polydorid Polychaete in Lake Grevelingen: An Enclosed Estuary in the SW Netherlands,
W89-00002 2H

Spatial and Temporal Variability of the Index of Biotic Integrity in Three Midwestern Streams,
W89-00026 2E

Influence of Temperature on Microhabitat Choice by Fishes in a California Stream,
W89-00027 2H

Habitat Requirements and Bioindicator Value of the Main Communities of Aquatic Vegetation in North-East Poland,
W89-00235 2H

Concentrations of Nitrogen and Phosphorus in Waters of Two Hypertrophic Lakes and Their Effect on the Quantity of Phytoplankton Biomass,
W89-00245 2H

Impacts of Navigation on Riverine Fish Production in the United States,
W89-00248 6G

Fish Production in the Kanawha River and its Relation To Barge Traffic,
W89-00249 6G

Contemporary Changes in Coastal Biocenoses of the Gdansk Bay (South Baltic), A Review,
W89-00254 2L

Differentiation of the Physical and Chemical Properties of Bottom Sediments in Phytocenoses of Myriophylletum verticillati Soo 1927, Potamogetonetum natantis Soo 1927 and Hydrocharitetum morsus-ranae Langendonck 1935 Associations,
W89-00259 2H

Microbial Biomass, Activity, and Community Structure of Water and Particulates Retrieved by Backflow from a Waterflood Injection Well,
W89-00334 5B

Habitat Use of Two Darter Species in Glover River, Oklahoma,
W89-00396 2H

Trophic State Gradients and Zooplankton and Zoobenthos Distribution in a Po River Delta Lagoon,
W89-00580 2L

Dynamics of Hydra Populations in Lake Zurich, Switzerland, and Lake Maggiore, Italy,
W89-00692 2H

Toxicity of Sea-Surface Microlayer: Effects of Hexane Extract on Baltic Herring (Clupea harengus) and Atlantic Cod (Gadus morhua) Embryos,
W89-00856 5C

Ecology of Freshwater Gastropods in the Central Canadian Region,
W89-01183 2H

AQUATIC PLANTS

Effects of the Season and of Water Chemistry on the Decomposition of Nymphaea alba L.: Weight Loss and Pyrolysis Mass Spectrometry of the Particulate Matter,
W89-00096 2H

Influence of Sediment Composition and Irradiance on the Growth and Morphology of Myriophyllum spicatum L.,
W89-00098 2H

High Rates of Production and Mortality of Submerged Sparganium emersum Rehman during Its Short Growth Season in a Eutrophic Danish Stream,
W89-00099 2H

Biomass, Productivity and Life History Traits of Juncus militaris Bigel. in Two Rhode Island (U.S.A.) Freshwater Wetlands,
W89-00100 2H

Leaf Production and Nitrogen and Phosphorus Tissue Content of Littorella uniflora (L.) Aschers. in Relation to Nitrogen and Phosphorus Enrichment of the Sediment in Oligotrophic Lake Hampen, Denmark,
W89-00101 5C

Richness of Aquatic Macrophyte Floras of Soft Water Lakes of Differing pH and Trace Metal Content in Ontario, Canada,
W89-00103 5C

Chemical Environment of Salvinia molesta Mitchell: Ionic Concentrations of Infested Waters,
W89-00106 5B

Ammonium and Nitrate Uptake by Aquatic Plants from Poorly Buffered and Acidified Waters,
W89-00112 5C

Nitrogen, Phosphorus and Potassium in Salvinia molesta Mitchell in the Field: Effects of Weather, Insect Damage, Fertilizers and Age,
W89-00113 2H

Effect of Sediment Depth and Sediment Type on the Survival of Vallisneria americana Michx Grown from Tubers,
W89-00114 2H

Effect of Several Methods of Aquatic Plant Control on Two Bilharzia-Bearing Snail Species,
W89-00117 4A

Peatland Soil-Plant Relationships in the New Forest,
W89-00122 2H

Carbon Source of the Water Soldier, Stratiotes aloides L.,
W89-00128 2H

Growth Strategies and Distribution of Isoetids in Scottish Freshwater Lochs,
W89-00129 5C

Interaction of Some Environmental Factors in the Danube Delta on the Delimitation of the Vital Space Occupied by the Reed, Mace Reed and Sedge Cenoses (Die Einwirkung einiger Umweltfaktoren des Donaudeltas auf die Abgrenzung des Lebensraumes von Schilf-, Rohrkolben- und Seggengesellschaften),
W89-00163 2H

Species Diversity of Algal Flora in Vishwamitri River, Baroda (India),
W89-00234 2H

Habitat Requirements and Bioindicator Value of the Main Communities of Aquatic Vegetation in North-East Poland,
W89-00235 2H

Spartina alterniflora Die-Back in Louisiana: Time-Course Investigation of Soil Waterlogging Effects,
W89-00286 2H

Experimental Studies on the Resiliency of Floating Typha Mats in a Freshwater Marsh,
W89-00287 2H

Structure of a Population of Lobelia dortmanna L. Along a Gradient of Increasing Depth in an Oligotrophic Lake,
W89-00525 2H

Seasonal Development of Lobelia Dortmanna L. and Annual Balance of Its Population Size in an Oligotrophic Lake,
W89-00526 2H

Decomposition of Roots of Three Plant Communities in a Dutch Salt Marsh,
W89-00527 2L

Factors Influencing Aboveground Production of Scirpus Marshes in the St. Lawrence Estuary, Quebec, Canada,
W89-00529 2L

Demographic Study of Aerial Shoots of Carex rostrata in Relation to Water Level,
W89-00530 2H

Sources of Watercourse Pollution in Italy and Mediterranean France, Assessed by Macrophytes,
W89-00563 5B

Ecology of Macroalgae in the Firth of Clyde,
W89-00815 2L

Saltmarshes of the Firth of Clyde,
W89-00830 2L

AQUATIC POPULATIONS

Primary Productivity of the Bot River Estuary, South Africa,
W89-00656 2L

Annual Cycle of Free-Floating Bacteria in the Bot River Estuary,
W89-00658 2L

Comparison of the Physiological Condition of the Southern Mullet Liza richardsoni (Smith), in a Closed Estuary and the Sea,
W89-00663 2L

Synopsis of the Impact of Artificially Opening the Mouth of the Bot River Estuary: Implications for Management,
W89-00666 2L

Eutrophication and Benthic Fauna of Three Mountain Lakes (Eutrophisation et Faune Benthique de Trois Lacs de Montagne),
W89-00695 5C

AQUATIC PRODUCTIVITY

Effects of River Discharge and Vertical Circulation on Aquatic Primary Production in a Turbid Louisiana (USA) Estuary,
W89-00005 2L

Seasonal Productivity Cycle of Phytoplankton and Controlling Factors in Lake Constance,
W89-00022 2H

Correlations between Salinity and Growth of the Seagrass Amphibolis antarctica (Labill.) Sonder & Aschers., in Shark Bay, Western Australia, Using a New Method for Measuring Production Rate,
W89-00102 2L

Effects of Sediment Properties on Benthic Primary Production in the Columbia River Estuary,
W89-00115 2L

Estimating Bacterial Production in Marine Waters from the Simultaneous Incorporation of Thymidine and Leucine,
W89-00729 7B

AQUATIC SOILS

Nitrogen Pools and Soil Characteristics of a Temperate Estuarine Wetland in Eastern Australia,
W89-00110 5B

AQUATIC WEED CONTROL

Effect of Gibberellic Acid and 2,4-D on Water Hyacinths,
W89-00105 4A

Effect of Several Methods of Aquatic Plant Control on Two Bilharzia-Bearing Snail Species,
W89-00117 4A

AQUATIC WEEDS

Chemical Environment of Salvinia molesta Mitchell: Ionic Concentrations of Infested Waters,
W89-00106 5B

AQUATIC WEEDS

Equations Relating Growth and Uptake of Nitrogen by Salvinia molesta to Temperature and the Availability of Nitrogen,
W89-00111 2H

Nitrogen, Phosphorus and Potassium in Salvinia molesta Mitchell in the Field: Effects of Weather, Insect Damage, Fertilizers and Age,
W89-00113 2H

AQUIFER CHARACTERISTICS

Storm Response of the Karstic Carbonate Aquifer of Southcentral Kentucky,
W89-00349 2A

Validity of the Environmental Chloride Method for Recharge Evaluation of Coastal Aquifers, India.
W89-00356 7B

Theoretical Analysis of Deviations from Local Equilibrium During Sorbing Solute Transport Through Idealized Stratified Aquifers,
W89-00987 5B

Pumping Tests in Nonuniform Aquifers: The Radially Symmetric Case,
W89-01196 2F

Hydrogeology of Two Saskatchewan Tills. I. Fractures, Bulk Permeability, and Spatial Variability of Downward Flow,
W89-01201 2F

AQUIFER MANAGEMENT

Analytical Solution for Aquifer Decontamination by Pumping,
W89-00977 5G

Management of a Tributary Aquifer,
W89-00978 4B

AQUIFER TESTING

Validity of the Environmental Chloride Method for Recharge Evaluation of Coastal Aquifers, India.
W89-00356 7B

AQUIFERS

Hydrogeological and Hydrogeochemical studies of the Unsaturated Flow in a Gravel Aquifer: Part II. Results of Long Term Soil-hydrological Measurements (Hydrogeologische und Hydrochemische Untersuchungen in der Ungesaettigten Zone eines Kiesgrundwasserleiters: Teil II. Ergebnisse Langjaehriger Bodenhydrologischer Messungen),
W89-00503 2F

Three-Dimensional Radial Dispersion in a Variable Velocity Flow Field,
W89-00715 5B

Treatment of Herbicides in Ground Water,
W89-00938 5F

Making the Most of Field-Measurable Ground Water Quality Parameters,
W89-00939 7B

Tracer Test Analysis of Anisotropy in Hydraulic Conductivity of Granular Aquifers,
W89-00940 2F

Screened Auger Sampling: The Technique and Two Case Studies,
W89-00945 5A

Theoretical Analysis of Deviations from Local Equilibrium During Sorbing Solute Transport Through Idealized Stratified Aquifers,
W89-00987 5B

MODALP: A Deterministic Rainfall-Runoff Model for Large Karstic Areas,
W89-01145 2F

Time-Dependent Macrodispersion for Solute Transport in Anisotropic Heterogeneous Aquifers,
W89-01245 2F

ARABIAN GULF

Sediments in the Estuarine Environment of the Tigris/Euphrates Delta; Iraq; Arabian Gulf,
W89-01083 2L

ARCH DAMS

Calculation of an Arch Dam on the Basis of Solving the Three-dimensional Problem of the Theory of Elasticity and Theory of Shells,
W89-00057 8A

ARCTIC

Microbially Mediated Mn(II) Oxidation in an Oligotrophic Arctic Lake,
W89-00335 2H

Characteristic Features of Supercooled Raindrops in the Mid-Winter Season of Arctic Canada,
W89-00418 2B

Runoff Generation in a Low Arctic Drainage Basin,
W89-01207 2A

Nitrate Trace Determinations in Snow and Firn Core Samples of Ice Shelves at the Weddell Sea, Antarctica,
W89-01258 5B

ARCTIC ZONE

Characteristic Features of Supercooled Raindrops in the Mid-Winter Season of Arctic Canada,
W89-00418 2B

Effects of Disturbances Along Hydroelectrical Transmission Corridors Through Peatlands in Northern Manitoba, Canada.
W89-00436 4C

Influence of an Arctic Large-Lakes System on Mesoclimate in South-Central Baffin Island, N.W.T., Canada,
W89-00437 2H

AREA-TIME INTEGRALS

Modified ATI Technique for Nowcasting Convective Rain Volumes over Areas,
W89-00090 2B

AREAL PRECIPITATION

Estimation of Catchment Rainfall Uncertainty and its Influence on Runoff Prediction,
W89-00892 2A

ARID CLIMATES

Problems of Rainfall-Runoff Modelling in Arid and Semiarid Regions,
W89-01144 2E

ARID LANDS

Predictability of Two Moisture Sources in the Namib Desert,
W89-00455 2B

Groundwater Recharge in Arid Regions: Review and Critique of Estimation Methods,
W89-00914 2F

National Water Management in the Republic of South Africa: Towards a Consultative Partnership with Diverse Users in a Semi-Arid Country,
W89-01029 6D

ARID-ZONE HYDROLOGY

Groundwater Recharge in Arid Regions: Review and Critique of Estimation Methods,
W89-00914 2F

ARIZONA

Multicriterion Selection of Wastewater Management Alternatives,
W89-00300 5D

El Nino and Its Effect on Precipitation in Arizona and Western New Mexico,
W89-00474 2B

AROCLORS

Sorption and Desorption Dynamics of Aroclor 1242 to Natural Sediment,
W89-00991 5B

AROMATIC COMPOUNDS

Tumor Frequencies and Contaminant Concentrations in Brown Bullheads from an Industrialized River and a Recreational Lake,
W89-00028 5C

Aliphatic and Polycyclic Aromatic Hydrocarbons in Urban Rain, Snow and Fog,
W89-00309 5B

Microbial Degradation of Xenobiotic, Aromatic Pollutants in Humic Water,
W89-00344 5B

Sediment-Water Partition Coefficients and HPLC Retention Factors of Aromatic Hydrocarbons,
W89-00560 5B

High Resolution Emission Spectroscopy (Shpol'skii Effect): A New Analytical Technique for the Analysis of Polycyclic Aromatic Hydrocarbons (PAH) in the Environmental Samples,
W89-00574 5A

Sedimentation of 74 PCB Congeners in the Upper Hudson River,
W89-00584 5B

Formation of 1-Nitropyrene by Photolysis of Pyrene in Water Containing Nitrite Ion,
W89-00586 5B

Photo-induced Toxicity of Polycyclic Aromatic Hydrocarbons to Larvae of the Fathead Minnow (Pimephales promelas),
W89-00595 5C

Degradation of Bisphenol A in Natural Waters,
W89-00600 5B

Biogeochemistry of Benz(a)anthracene at the Sediment-Water Interface,
W89-00612 5B

Analysis of Halogenated Polycyclic Aromatic Hydrocarbons in Urban Air, Snow and Automobile Exhaust,
W89-00613 5B

Determination of Substituted Aromatic Amines in Water and Sediment Samples,
W89-00738 5A

Degradation of Polycyclic Aromatic Hydrocarbons: III. Reaction Products of the Ozonolysis of Further Polycyclic Aromatic Hydrocarbons in Aqueous Systems (Zum Abbau von Polycyclischen Aromatischen Kohlenwasserstoffen: III. Reaktionsprodukte der Umsetzung von Weiteren Polycyclischen Aromatischen Kohlenwasserstoffen in Wasser mit Ozon),
W89-00739 5F

ARSENIC

Atmospheric Deposition of Arsenic and Association with Acid Precipitation,
W89-00431 5B

Effect of pH and Contact Time on the Concentration of As(III) and As(V) in Coal Ash Systems,
W89-00624 5E

Distribution of Arsenic in the Sediments and Biota of Hilo Bay, Hawaii,
W89-00677 5B

ARTIC ZONE
Ecohydrological Approach to Floral and Vegetational Patterns in Arctic Landscape Ecology,
W89-00435 2H

ARTIFICIAL LAKES
Zooplankton Population of Man-Made Lakes in Abruzzi's Appennines: Campotosto Lake (Popolamento Zooplanctonico di un Lago di Sbarramento Dell'Appennino Abruzzese: Il Lago di Campotosto),
W89-00197 2H

ARTIFICIAL PRECIPITATION
Persistent Effects of Cloud Seeding with Silver Iodide,
W89-00091 3B

ARTIFICIAL RECHARGE
Water Catchment Installations Harmonized with Ecological Aspects - An Example in Berlin (West),
W89-00926 6B

In-Situ Method for Monitoring Layered Hydraulic Impedance Development During Artificial Recharge with Turbid Water,
W89-01205 2F

ARTIFICIAL SUBSTRATES
Pioneer Colonization and Interaction of Photosynthetic and Heterotrophic Microorganisms on an Artificial Substrate of Polyurethane Foam in E. J. Beck Lake, Illinois,
W89-00398 2H

ASPHALT
Deformation of Dams with a Facing and Their Seismic Stability,
W89-00070 8D

ATLANTIC OCEAN
Life Cycle Effects of Cloud Clusters on the Moisture Distribution over the Eastern Atlantic,
W89-00417 2B

ATMOSPHERE WATER
Winter Diurnal Trends of Sierra Nevada Supercooled Liquid Water and Precipitation,
W89-00089 3B

ATMOSPHERIC PHYSICS
Charge Induced on a Conducting Cylinder by a Point Charge and Its Application to the Measurement of Charge on Precipitation,
W89-00762 7B

ATMOSPHERIC WATER
Theoretical Evaluation of Water Oligomer Populations in the Earth's Atmosphere,
W89-00763 2B

Liquid Cloudwater Collection Using Modified Mohnen Slotted Rods,
W89-00764 7B

Fog Drip as a Source of Groundwater Recharge in Northern Kenya,
W89-00984 2F

ATOLLS
Development and Management of Groundwater Resources on Diego Garcia,
W89-00423 4B

ATOMIC ABSORPTION SPECTROMETRY
Determination of Organotins in Natural Waters by Toluene Extraction and Graphite Furnace AAS,
W89-00743 5A

ATOMIC ABSORPTION SPECTROPHOTOMETRY
Solubility of Colloidal Ferric Hydroxide and its Relevance to Iron Concentrations in River Water,
W89-01081 2K

ATOMIC ABSORPTION SPECTROSCOPY
Sediment Analysis: Lability of Selectively Extracted Fractions,
W89-00744 5A

Speciation Studies of Copper and Magnesium in Duckweed Extract Using Interfaced HPLC and Thermospray Neubulizer Flame AA,
W89-00886 5D

ATRAZINE
Analysis of Atrazine in Underground Waters at Part Per Trillion Levels as an Early Warning Method for Contamination and for Soil Distribution Studies,
W89-00596 5A

AUSTRALIA
Outwelling from Tropical Tidal Salt Flats,
W89-00140 2L

Politics of Hydro-Megaprojects: Damming with Faint Praise in Australia, New Zealand, and British Columbia,
W89-00836 6E

Landscape and Rainfall Indices for Prediction of Streamflow Similarities in the Hunter Valley, Australia,
W89-00972 2E

Coastal Management Issues for the Mouth of the River Murray, South Australia,
W89-01072 6E

AUTOANALYZERS
National Field Evaluation of a Defined Substrate Method for the Simultaneous Enumeration of Total Coliforms and Escherichia coli from Drinking Water: Comparison with the Standard Multiple Tube Fermentation Method,
W89-00337 5A

AUTOMATION
Improvement of the Electrical Equipment and Control Systems to the Lock Mechanisms of the Moscow Canal,
W89-00052 8C

Power Facilities of the Moscow Canal,
W89-00053 8C

Adjusting and Modernization of the System Converting Units to Synchronous Capacitor Operation at the Sayano-Shushenskoe Hydroelectric Station,
W89-00074 8C

Making the Right Moves in SCADA Selection,
W89-01103 5F

Automation of Conveyor Transport at the Construction Site of Earth Dams,
W89-01173 8H

AZOV SEA
Changes in the Ecosystem of the Azov Sea in Relation to Economic Development in the Basin,
W89-01192 6G

BACKWATER
Water Quality of the Tisza River and the Alpar Backwater,
W89-00143 5B

Seasonal Composition, Biomass and Primary Productivity of the Phytoplankton in Lakitelek Backwater during 1980 and 1983,
W89-00144 2H

Seasonal Changes of Phytoplankton in the Backwater Bokros,
W89-00147 2H

BACTERIA
Scanning Electron Microscopy of Bacteria and Diatoms Attached to a Submerged Macrophyte in an Increasingly Polluted Stream,
W89-00132 5C

Microbiological Examination of the Carska Bara Swamp Water,
W89-00146 2H

Efficacy of Chemical Dosing Methods for Isolating Nontuberculous Mycobacteria from Water Supplies of Dialysis Centers,
W89-00343 5A

Feeding of a Freshwater Flagellate, Bodo saltans, on Diverse Bacteria,
W89-00381 2H

Effect of Culture History on the Determination of Biodegradation Kinetics by Batch and Fed-Batch Techniques,
W89-00513 5D

Bacteriological Contamination of the Eastern Part of the Gulf of Trieste (North Adriatic) Due to Sewage Discharge,
W89-00577 5B

Association Between Seawater Pollution as Measured by Bacterial Indicators and Morbidity Among Bathers at Mediterranean Bathing Beaches of Israel,
W89-00579 5C

Relationship between Numbers of Enteroviruses and Bacteriophages Infecting Bacteroides fragilis in Different Environmental Samples,
W89-00645 5A

Isolation, Identification and Characterisation of Filamentous and Floc-Forming Bacteria from Activated Sludge Flocs,
W89-00648 5D

Annual Cycle of Free-Floating Bacteria in the Bot River Estuary,
W89-00658 2L

Rapid Detection of Total and Fecal Coliforms in Water by Enzymatic Hydrolysis of 4-Methylumbelliferone-beta-D-Galactoside,
W89-00734 5A

Dissolved Organic Carbon and Manganese in the Boundary of the Oxic and Anoxic Layers in Lakes Fukami-ike and Suigetsu-ko,
W89-00771 2H

Epidemiological Study of the Legionella pneumophila Presence in Potable Water in Alicante,
W89-00925 5A

Activity Assessment in Drinking Water Bacteriology - A Comparison of Methods and Possibilities,
W89-00928 5A

Clearance of Bacteria-Sized Particles by Natural Populations of Nanoplankton in the Chesapeake Bay Outflow Plume,
W89-01032 2L

Bacterial Production in Fresh and Saltwater Ecosystems: A Cross-System Overview,
W89-01034 2H

BACTERIA

Myxococcal Predation on Cyanobacterial Populations: Nutrient Effects,
W89-01050 2H

Microbial Characterization of Municipal Wastewater at a Spray Irrigation Site: the Lubbock Infection Surveillance Study,
W89-01124 7B

Release of Micro-algal Photosynthate and Associated Bacterial Uptake and Heterotrophic Growth,
W89-01187 2H

BACTERIAL ANALYSIS

Development of Microorganisms on the Background of Organic Matter in Forest Ecosystem Waters,
W89-00080 2H

Detection and Enumeration of Actinomycetes in the Austrian Part of the Danube by Means of Selective Membrane Filtration Methods Together With Some Other Bacteriological Parameters (Nachweis und Vorkommen von Actinomyceten in der osterreichischen Donau mittels selektiver Membranfilterverfahren, zusammen mit einigen anderen bakteriologischen Parametern),
W89-00174 5A

Incidence of Coliphage in Potable Water Supplies,
W89-00338 5F

Efficacy of Chemical Dosing Methods for Isolating Nontuberculous Mycobacteria from Water Supplies of Dialysis Centers,
W89-00343 5A

Evaluating the Modifications to the MF Total Coliform Method for Drinking Water with High Noncoliform Backgrounds,
W89-00427 5A

Rapid Specific Environmental Coliform Monitoring,
W89-00445 5A

Isolation, Identification and Characterisation of Filamentous and Floc-Forming Bacteria from Activated Sludge Flocs,
W89-00648 5D

Comparison of Bacterial Indicators and Sampling Programs for Drinking Water Systems,
W89-00733 5A

Bacterial Water Quality Responses to Four Grazing Strategies: Comparisons with Oregon Standards,
W89-01170 5B

BACTERIAL PHYSIOLOGY

Metabolic Processes Involved in Repair of Escherichia coli Cells Damaged by Exposure to Acid Mine Water,
W89-00727 5C

BACTERIOPHAGE

Relationship between Numbers of Enteroviruses and Bacteriophages Infecting Bacteroides fragilis in Different Environmental Samples,
W89-00645 5A

Detection of Environmental Viruses in Sludge: Enhancement of Enterovirus Plaque Assay Titers with 5-Iodo-2'-Deoxyuridine and Comparison to Adenovirus and Coliphage Titers,
W89-01220 5A

BALTIC SEA

Contemporary Changes in Coastal Biocenoses of the Gdansk Bay (South Baltic), A Review,
W89-00254 2L

Developmental Defects in Pelagic Fish Embryos from the Western Baltic,
W89-00315 5C

Toxicity of Sea-Surface Microlayer: Effects of Hexane Extract on Baltic Herring (Clupea harengus) and Atlantic Cod (Gadus morhua) Embryos,
W89-00856 5C

BANGLADESH

Effect of Upgrading a Tubewell Water Supply in Rural Areas of Bangladesh,
W89-00920 5F

BANK EROSION

Regularities in the Formation of Curved Channels,
W89-00041 2J

BANK PROTECTION

Evaluation of the Reliability of Wave-Protection Slab Revetments of Embankment Slopes,
W89-01176 8D

BANKS

Stability of Sand Slopes in the Groundwater Discharge Zones,
W89-01174 8D

BARGES

Fish Production in the Kanawha River and its Relation To Barge Traffic,
W89-00249 6G

BARRIER ISLANDS

Septic System Performance on a Coastal Barrier Island,
W89-01163 5D

BASE FLOW

Derivation of Baseflow Recession Constant Using Computer and Numerical Analysis,
W89-01142 2E

BASELINE STUDIES

Macrobenthos of the Beatrice Oilfield, Moray Firth, Scotland,
W89-00782 2L

BASINS

Role of Sewage Effluent in the Accumulation of Macroalgal Mats on Intertidal Mudflats in Two Basins in Southern England,
W89-00159 5C

BASS

Habitat Suitability and Fish Production: A Model Evaluation for Rock Bass in Two Virginia Streams,
W89-00294 2H

Sensitivity of Young Striped Bass to Organic and Inorganic Contaminants in Fresh and Saline Waters,
W89-00320 5C

Effects of Temperature and Streamflow on Time and Duration of Spawning by Smallmouth Bass,
W89-00373 2H

BATHYMETRY

Bathymetry, Environmental Parameters and Sediments of the Bot River Estuary, S.W. Cape Province.
W89-00651 2L

BAVARIA

Phytoplankton Studies of Slowly Running Waters: Rivers Danube and Vils (Phytoplanktonstudien an langamfliessenden Gewassern: Donau und Vils),
W89-00172 2E

BAY OF FUNDY

Nutrient Dynamics in Cumberland Basin - Chignecto Bay, A Turbid Macrotidal Estuary in the Bay of Fundy, Canada,
W89-00152 2L

Adventures in Holistic Ecosystem Modelling: The Cumberland Basin Ecosystem Model,
W89-00675 2L

BAYS

Correlations between Salinity and Growth of the Seagrass Amphibolis antarctica (Labill.) Sonder & Aschers., in Shark Bay, Western Australia, Using a New Method for Measuring Production Rate,
W89-00102 2L

Nutrient Dynamics in Cumberland Basin - Chignecto Bay, A Turbid Macrotidal Estuary in the Bay of Fundy, Canada,
W89-00152 2L

Comparison of Nutrients in the Interstitial Water of Reducing (Tamar Estuary) and Oxic (Carmarthen Bay) Coastal Sediments,
W89-00156 2L

Preliminary Study on the Migration and Transformation of Heavy Metals in the Sewage-Seawater Mixing Zone of Jinzhou Bay, (in Chinese),
W89-00199 5B

Environmental Conditions in Abu Kir Bay, East of Alexandria: I. Physico-chemical Characteristics and Water Circulation,
W89-00565 5B

Environmental Conditions in Abu Kir Bay, East of Alexandria: II. Plankton Distribution, Downstream from Land-Based Effluents,
W89-00578 5C

BEACH EROSION

Great Lakes Shore Erosion,
W89-00133 4D

BEACHES

Stokes Surfaces and the Effects of Near-Surface Groundwater-Table on Aeolian Deposition,
W89-00410 2J

Coastal Topography of the Moray Firth,
W89-00775 2L

Development of Mass Blooms of Photosynthetic Bacteria on Sheltered Beaches in Scapa Flow, Orkney Islands,
W89-00795 2L

Results of Ecological Monitoring of Three Beaches Polluted by the 'Amoco Cadiz' Oil Spill: Development of Meiofauna from 1978 to 1984,
W89-01031 5C

Measurement of Shallow Water Wave Direction for Longshore Sediment Transport,
W89-01082 2J

BEATRICE OILFIELD

Macrobenthos of the Beatrice Oilfield, Moray Firth, Scotland,
W89-00782 2L

Comparison of the Fauna Retained On 0.5 mm and 1.0 mm Meshes from Benthic Samples Taken in the Beatrice Oilfield, Moray Firth, Scotland,
W89-00783 2L

Pollution Control and Environmental Planning for the Beatrice Oilfield and Nigg Oil Terminal,
W89-00788 5G

Degradation of Low-Toxicity Oil-Based Drilling Mud in Benthic Sediments around the Beatrice Oilfield,
W89-00792 5B

BEAULY FIRTH
Water Quality in the Inverness and Beauly Firths,
W89-00789 5B

BED-LOAD DISCHARGE
Sediment Delivery in a Semi-arid Coastal Stream,
W89-00346 2J

BEDROCK
Simulation of Regional Ground Water Flow in Bedrock, Southwestern New York-Northwestern Pennsylvania,
W89-00882 2F

BEHAVIOR
Active Emergence of Meiofauna from Intertidal Sediment,
W89-01037 2L

BELGIUM
Nitrogen Budget of the Scheldt Hydrographical Basin,
W89-00155 5B

Repercussions of a CO2 Doubling on the Water Cycle and on the Water Balance - A Case Study for Belgium,
W89-00355 2A

BENTHIC ENVIRONMENT
Pesticidal Effects on Chironomid Larvae,
W89-00079 5C

Water Column Productivity Attributable to Displaced Benthic Diatoms in Well-Mixed Shallow Estuaries,
W89-00297 2L

Periphyton, Benthic Invertebrates and Fishes as Biological Indicators of Water Quality in the East Branch Brandywine Creek,
W89-00314 5A

Benthic Chamber for Use in Rivers: Testing against Oxygen Mass Balances,
W89-00488 7B

K-Systems Analysis for Determining the Factors Influencing Benthic Microfloral Productivity in a Louisiana Estuary, USA,
W89-01035 2L

BENTHIC FAUNA
Structure of Macrobenthic Biomass in the Gravel Bed of the Pre-Alpine Loisach River (Die Struktur der makrobenthischen Biomasse in einem voralpinen Schotterbett am Beispiel der mittleren Loisach),
W89-00167 2H

Population Dynamics and Production of Chironomidae (Diptera) at 2 m depth in Lake Esrom, Denmark,
W89-00182 2H

Effects of High Levels of Polycyclic Aromatic Hydrocarbons on Sediment Physicochemical Properties and Benthic Organisms in a Polluted Stream,
W89-00589 5C

Benthic Macrofauna of the Bot River Estuary, South Africa, with a Note on Its Meiofauna,
W89-00660 2L

Seasonal Changes of the Profundal Macrobenthic Community in a Polluted Lake,
W89-00693 5C

Eutrophication and Benthic Fauna of Three Mountain Lakes (Eutrophisation et Faune Benthique de Trois Lacs de Montagne),
W89-00695 5C

Comparison of the Fauna Retained On 0.5 mm and 1.0 mm Meshes from Benthic Samples Taken in the Beatrice Oilfield, Moray Firth, Scotland,
W89-00783 2L

Sub-Littoral Fauna of the Inverness, Cromarty and Dornoch Firths,
W89-00784 2L

Response of Benthic Meiofauna to Nutrient Enrichment of Experimental Marine Ecosystems,
W89-01033 5C

Active Emergence of Meiofauna from Intertidal Sediment,
W89-01037 2L

BENTHIC FLORA
Effects of Sediment Properties on Benthic Primary Production in the Columbia River Estuary,
W89-00115 2L

Seasonal Fluctuations in the Species Composition of Phytoplankton and Phytobenthos in the Lobau Near Vienna (Jahreszeitliche Schwankungen in der Zusammensetzung des Phytoplanktons und Phytobenthos in Altwassern der Lobau bei Wien),
W89-00166 2H

Benthic Cyanophyte Associations in Streams and Lakes (Benthische Cyanophyten-Gemeinschaften in Bachen und Seen),
W89-00184 2H

Influence of Microphytobenthos on the Nutrient Flux between Sediment and Water: A Laboratory Study,
W89-01036 2L

BENTHOS
Dredging Activities in the Dutch Wadden Sea: Effects on Macrobenthic Infauna,
W89-00151 2L

Examination of the Connection Between the Patchiness of Benthic Nutrient Efflux and Epiphytobenthos Patchiness on Intertidal Flats,
W89-00161 2L

Structure of Macrobenthic Biomass in the Gravel Bed of the Pre-Alpine Loisach River (Die Struktur der makrobenthischen Biomasse in einem voralpinen Schotterbett am Beispiel der mittleren Loisach),
W89-00167 2H

Effects on the Benthic Fauna of Embanking an Intertidal Flat Area (The Markiezaat, Eastern Scheldt Estuary, The Netherlands),
W89-00676 6G

Algal Studies of the River Ely, South Wales, U.K.: II. Epilithic Algae,
W89-00679 2H

Seasonal Changes of the Profundal Macrobenthic Community in a Polluted Lake,
W89-00693 5C

Macrobenthos of the Beatrice Oilfield, Moray Firth, Scotland,
W89-00782 2L

Impact of River Regulations on Invertebrate Communities in the U.K.,
W89-00959 4A

BENTONITE
Treatment of Dye-Containing Effluents with Different Bentonites,
W89-00615 5D

BENZANTHRACENE
Biogeochemistry of Benz(a)anthracene at the Sediment-Water Interface,
W89-00612 5B

BENZENES
Simultaneous Gas Chromatographic Determination of Nitrobenzene and 2,4-Dinitrophenol in Nitrobenzene Manufacturing Plant Wastewater,
W89-00479 5A

BENZOPYRENE
Effect of 3,4 Benzopyrene on the Photosynthetic and Respiratory Intensity of the Green Alga Scenedesmus quadricauda (Der Einfluss von 3,4-Benzpyren aud die Photosynthese- une Respirationsintensitat der Gruenalge Scenedesmus quadricauda),
W89-00135 5C

BERLIN
Water Catchment Installations Harmonized with Ecological Aspects - An Example in Berlin (West),
W89-00926 6B

BERMUDA
Local Influences on the Composition of Precipitation on Bermuda,
W89-00405 2A

Occurrence and Distribution of Trace Organic Compounds in Bermuda Precipitation,
W89-01148 5B

BICARBONATES
Carbon Source of the Water Soldier, Stratiotes aloides L.,
W89-00128 2H

BIOACCUMULATION
Acclimatization of Roach, Rutilus rutilus (L.), to Toxic Components of Kraft Pulp Mill Effluents,
W89-00087 5C

Investigations of the Ecotoxicological Effect of an Herbicide in an Aquatic Model Ecosystem: II. Food Chain Significance and Pesticide Balance (Untersuchungen zur okotoxikologischen Wirkung eines Herbizids in einem aquatischen Modellokosystem: II. Nahrungskettenprobleme und Schadstoffbilanzierung),
W89-00175 5C

Nitrogen Dynamics in Lower Narragansett Bay: II. Phytoplankton Uptake, Depletion Rates of Nitrogenous Nutrient Pools, and Estimates of Ecosystem Remineralization,
W89-00215 2L

Investigations of Chlorinated Thiophenes: A Group of Bioaccumulable Compounds Identified in the Effluents from Kraft Bleaching,
W89-00360 5B

Two Toxicants, Mercury and Tin in the Gulf of Iskenderun,
W89-00570 5B

Bioavailability of Polychlorinated Dibenzo-p-dioxins and Dibenzofurans from Contaminated Wisconsin River Sediment to Carp,
W89-00583 5B

Survey of Mercury, Lead and Cadmium in Muscle of British Freshwater Fish,
W89-00587 5B

Age to PCB Concentration Relationship with the Striped Bass (Morone saxatilis) in the Hudson River and Long Island Sound,
W89-00597 5B

Monitoring of PCDDs in Osaka Bay Using Blue Mussel,
W89-00604 5B

Mercury Pollution in the Estuarine Region around Bombay Island,
W89-00638 5B

BIOACCUMULATION

Trace Metals in the Common Mussel Mytilus edulis (L.) in the Clyde Estuary,
W89-00823 5B

Terrestrial Bioaccumulation Potential of Phenolic Compounds,
W89-00998 5B

Use of Factorial Experimental Design to Evaluate How Biotic and Abiotic Factors Influence Cadmium Accumulation in the Unicellular Alga Dunaliella bioculata,
W89-01043 5B

Organochlorine and Mercury Residues in Wild Mink and Otter: Comparison with Fish,
W89-01093 5B

BIOASSAY

Toxicity Bioassay of Technical and Commercial Formulations of Carbaryl to the Freshwater Catfish, Clarias batrachus,
W89-00086 5C

Impact of Manganese Intoxication on the Blood Pyruvic Acid of a Freshwater Tropical Perch Colisa fasciatus,
W89-00263 5A

Predictive Structure-Toxicity Model with Daphnia magna,
W89-00591 5C

Contaminant Concentrations and Toxicity of Sea-Surface Microlayer Near Los Angeles, California,
W89-00857 5C

Laboratory Study of the Accumulation and Toxicity of Contaminants at the Sea Surface from Sediments Proposed for Dredging,
W89-00858 5E

Comparison of Three Sediment Bioassay Methods Using Detroit River Sediments,
W89-01097 5A

Detection of Environmental Viruses in Sludge: Enhancement of Enterovirus Plaque Assay Titers with 5-Iodo-2'-Deoxyuridine and Comparison to Adenovirus and Coliphage Titers,
W89-01220 5A

Evaluation and Comparison of Two Short-Term Fathead Minnow Tests for Estimating Chronic Toxicity,
W89-01224 5A

Metallothionein-Like Heavy Metal Binding Protein Levels in Asiatic Clams Are Dependent on the Duration and Mode of Exposure to Cadmium,
W89-01228 5B

Assessment of Selenium Toxicity in Algae Using Turbidostat Culture,
W89-01230 5C

BIOASSAYS

Bromothymol-Blue Test: A Simple Algal Bioassay and its Use for Herbicide Screening,
W89-00192 5A

BIOCHEMICAL OXYGEN DEMAND

New Measure of Interdependence Among Several Pollutants,
W89-01131 5D

Comparison of Chemical Biodegradation Rates in BOD Dilution and Natural Waters,
W89-01158 5B

BIOCHEMISTRY

Determination of Hydrophilic Thiols in Sediment Porewater Using Ion-Pair Liquid Chromatography Coupled to Electrochemical Detection,
W89-00266 7B

BIOCHEMISTRY. IONS

Ca(+2)-Stress, Biological Response and Particle Aggregation in the Aquatic Habitat,
W89-00669 2K

BIODEGRADATION

Bacterial Degradation of Crude Oil Water Pollutants in Danube Water (Die bakterielle Degradation von Erdolkohlenwasserstoffen im Donauwasser),
W89-00168 5B

Effects of Co-Occurring Aromatic Hydrocarbons on Degradation of Individual Polycyclic Aromatic Hydrocarbons in Marine Sediment Slurries,
W89-00339 5B

Microbial Degradation of Xenobiotic, Aromatic Pollutants in Humic Water,
W89-00344 5B

Contribution of Plasmids to Naphthalene Catabolism in Sediment Bacteria,
W89-00378 5B

Effect of Mangrove Humic-Like Substances on Biodegradation Rate of Detritus,
W89-00476 2L

Effect of Culture History on the Determination of Biodegradation Kinetics by Batch and Fed-Batch Techniques,
W89-00513 5D

Estimate of the Variability in Biotransformation Kinetics of Xenobiotics in Natural Waters by Aufwuchs Communities,
W89-00559 5B

Degradation of Bisphenol A in Natural Waters,
W89-00600 5B

Evaluation of Aquatic Environmental Fate of 2,4,6-Trichlorophenol with a Mathematical Model,
W89-00616 5B

Review of the Behaviour and Utilization of Polycarboxylic Acids as Detergent Builders,
W89-00620 5D

Degradation and Formation of Refractory DOM by Bacteria During Simultaneous Growth on Labile Substrates and Persistent Lake Water Constituents,
W89-00691 2H

Degradation of Low-Toxicity Oil-Based Drilling Mud in Benthic Sediments around the Beatrice Oilfield,
W89-00792 5B

Simulation Model for Biotransformation of Xenobiotics and Chemotaxis in Soil Columns,
W89-00989 5B

Aerobic Biodegradation of Natural and Xenobiotic Organic Compounds By Subsurface Microbial Communities,
W89-01090 5B

Comparison of Chemical Biodegradation Rates in BOD Dilution and Natural Waters,
W89-01158 5B

Numerical Transport Model for Oxygen- and Nitrate-Based Respiration Linked to Substrate and Nutrient Availability in Porous Media,
W89-01251 5D

BIODEGRATATION

Biotic and Abiotic Degradation Rates of Methyl Parathion in Freshwater and Estuarine Water and Sediment Samples,
W89-00601 5B

BIOFILM

Effect of Sulfate and Organic Matter on The Hydrogen Sulfide Formation in Biofilms of Filled Sanitary Sewers,
W89-00510 5D

BIOFILTERS

Effects of Biofilter Media on the Performance of Anaerobic Hybrid Reactors,
W89-00626 5D

BIOGEOCHEMISTRY

Local Influences on the Composition of Precipitation on Bermuda,
W89-00405 2A

BIOGRAPHIES

Works of S. V. Shestoperov on Frost Resistance of Hydrotechnical Concrete,
W89-00061 8F

BIOINDICATORS

Freshwater Mollusks as Indicators of Trophic Conditions in Coastal Lakes of Southern Brazil (Moluscos Dulceaquicolas Como Indicadores de Condicoes Troficas em Lagoas Costeiras do Sul do Brasil),
W89-00008 5A

Monitoring of Mercury Pollution in Dutch Coastal Waters by Means of the Teleostean Fish Zoarces Viviparus,
W89-00150 5C

Limits of Growth of Five Chlorella Species in the Presence of Toxic Heavy Metals,
W89-00191 5C

Could Benthic Algae be used as Water Quality Indicators (Konnen Benthische Algen zur Wassergute-Bestimmung Herangezogen Werden),
W89-00194 5A

Habitat Requirements and Bioindicator Value of the Main Communities of Aquatic Vegetation in North-East Poland,
W89-00235 2H

Indicatory Role of Some Invertebrates for Quality of Water in the Vistula River and in Subsequent Stages of Its Treatment,
W89-00236 5A

Impact of Manganese Intoxication on the Blood Pyruvic Acid of a Freshwater Tropical Perch Colisa fasciatus,
W89-00263 5A

Periphyton, Benthic Invertebrates and Fishes as Biological Indicators of Water Quality in the East Branch Brandywine Creek,
W89-00314 5A

Monitoring of PCDDs in Osaka Bay Using Blue Mussel,
W89-00604 5B

Relationship between Numbers of Enteroviruses and Bacteriophages Infecting Bacteroides fragilis in Different Environmental Samples,
W89-00645 5A

Snail Distributions in Lake Erie: The Influence of Anoxia in the Southern Central Basin Nearshore Zone,
W89-00683 2A

Comparison of Bacterial Indicators and Sampling Programs for Drinking Water Systems,
W89-00733 5A

Trace Metals in the Common Mussel Mytilus edulis (L.) in the Clyde Estuary,
W89-00823 5B

Results of Ecological Monitoring of Three Beaches Polluted by the 'Amoco Cadiz' Oil

Spill: Development of Meiofauna from 1978 to 1984,
W89-01031 5C

Micronucleus Test: Examples of Application to Marine Ecology,
W89-01042 5A

BIOLOGICAL MAGNIFICATION
Investigations of the Ecotoxicological Effect of an Herbicide in an Aquatic Model Ecosystem: II. Food Chain Significance and Pesticide Balance (Untersuchungen zur okotoxikologischen Wirkung eines Herbizids in einem aquatischen Modellokosystem: II. Nahrungskettenprobleme und Schadstoffbilanzierung),
W89-00175 5C

Terrestrial Bioaccumulation Potential of Phenolic Compounds,
W89-00998 5B

BIOLOGICAL MEMBRANES
Application of Biologically Activated Sorptive Columns for Textile Waste Water Treatment,
W89-00632 5D

BIOLOGICAL OXYGEN DEMAND
Cotton Yarn and Fabric Finishing Wastewater Treatment in Upflow Anaerobic Filter,
W89-00277 5D

Comparison of Instream and Laboratory Methods of Measuring Sediment Oxygen Demand,
W89-00869 7B

BIOLOGICAL PROPERTIES
Degradation and Formation of Refractory DOM by Bacteria During Simultaneous Growth on Labile Substrates and Persistent Lake Water Constituents,
W89-00691 2H

BIOLOGICAL TREATMENT
Binding and Removal of Aluminum Ions in Waters by an Algal Biomass.
W89-00478 5F

Operation of a Three-Phase Biofilm Fluidized Sand Bed Reactor for Aerobic Wastewater Treatment,
W89-00747 5D

Sewage Purification in South Africa - Past and Present,
W89-00933 5D

Nitrate Removal from Water Supplies Using Biological Denitrification,
W89-01237 5F

BIOLOGICAL WASTEWATER TREATMENT
Chromium Removal from Water by Three Species of Duckweeds,
W89-00109 5D

Animal Wastes Media for Spirulina Production,
W89-00136 5D

Selected Dyes for Residence Time Distribution Evaluation in Bioreactors,
W89-00404 5D

Ammonia Nitrogen Removal in Attached-Growth Ponds,
W89-00489 5D

Effect of Sulphide on the Anaerobic Degradation of Propionate,
W89-00625 5D

Treatability Studies of Textile Wastewater,
W89-00627 5D

Assessment of the Toxicity of Heavy Metals to the Anaerobic Digestion of Sewage Sludge,
W89-00631 5D

Comparison of Co-Digestion Performance of Two Differently Collected Organic Fractions of Municipal Solid Waste with Sewage Sludges,
W89-00643 5D

Liquid Effluents of the Fish Canning Industries of Rio de Janeiro State: Treatment Alternatives,
W89-00646 5D

Activated Sludge Systems with Biomass Particle Support Structures,
W89-01256 5D

BIOMANIPULATION
Food Web Manipulation Without Nutrient Control: A Useful Strategy in Lake Restoration,
W89-00019 5G

BIOMASS
Biomass and Nutritive Potential of Vallisneria americana Michx in Navigation Pool 9 of the Upper Mississippi River,
W89-00093 2H

Biomass Production and Nutrient Cycling in Aquatic Macrophyte Communities of the Chowan River, North Carolina,
W89-00097 2H

Biomass, Productivity and Life History Traits of Juncus militaris Bigel. in Two Rhode Island (U.S.A.) Freshwater Wetlands,
W89-00100 2H

Relationship between Zooplankton Development and Environmental Conditions in Different Types of Lakes in the Zone of Temperate Climate.
W89-00138 2H

Structure of Macrobenthic Biomass in the Gravel Bed of the Pre-Alpine Loisach River (Die Struktur der makrobenthischen Biomasse in einem voralpinen Schotterbett am Beispiel der mittleren Loisach),
W89-00167 2H

Recurrence of Daphnia rosea in Lake Tahoe: Analysis of a Population Pulse,
W89-00216 2H

Concentrations of Nitrogen and Phosphorus in Waters of Two Hypertrophic Lakes and Their Effect on the Quantity of Phytoplankton Biomass,
W89-00245 2H

Estimation of Phytoplankton Biomass and Production, and Organic Matter Decomposition in Three Small Field-Ponds,
W89-00252 2H

Qualitative and Quantitative Changes in Phytoplankton on the Background of Physicochemical Changes in the Water of Swietokrzyskie Lake in the Years 1977-1979,
W89-00258 5C

Zooplankton and Some Environmental Conditions in the Bot River Estuary,
W89-00659 2L

Benthic Macrofauna of the Bot River Estuary, South Africa, with a Note on Its Meiofauna,
W89-00660 2L

Large-Scale and Long-Term Variations in the Zooplankton Community of the Gullmar Fjord, Sweden, in Relation to Advective Processes,
W89-01038 2L

Activated Sludge Systems with Biomass Particle Support Structures,
W89-01256 5D

BIOMONITORING
Developmental Defects in Pelagic Fish Embryos from the Western Baltic,
W89-00315 5C

Application and Testing of an Index of Biotic Integrity in Small, Coolwater Streams,
W89-00323 2H

BIOTIC INTEGRITY
Application and Testing of an Index of Biotic Integrity in Small, Coolwater Streams,
W89-00323 2H

BIOTRANSFORMATION
Mechanisms of DNA Utilization by Estuarine Microbial Populations,
W89-00340 2L

Environmental Fate of Chloroguaiacols and Chlorocatechols,
W89-00369 5B

Effects of Acidification on Mercury Methylation, Demethylation, and Volatilization in Sediments from an Acid-Susceptible Lake,
W89-00731 5B

Simulation Model for Biotransformation of Xenobiotics and Chemotaxis in Soil Columns,
W89-00989 5B

Manganese Oxidation in pH and O2 Microenvironments Produced by Phytoplankton,
W89-01045 2K

Toxicity of Alkyllead Salts to Anaerobic Nitrogen Transformations in Sediment,
W89-01167 5C

BIOTURBATION
Bioturbation, Microbial Activity and Sediment Properties in an Estuarine Ecosystem,
W89-00806 2L

Mud-Burrowing Megafauna of the Clyde Sea Area,
W89-00821 2L

BIPHENYL
Photochemical Reaction of Biphenyl in Water Containing Nitrite or Nitrate Ion,
W89-00593 5B

BIRCH TREES
Differences in the Spectral Characteristics of Birch Canopies Exposed to Simulated Acid Rain,
W89-00849 5C

BIRKENES MODEL
Assessing the Birkenes Model of Stream Acidification Using a Multisignal Calibration Methodology,
W89-00974 7B

BIRKENES MODELS
Multisignal Automatic Calibration Methodology for Hydrochemical Models: A Case Study of the Birkenes Model,
W89-00973 5B

BISMUTH
Determination of Traces of Bismuth in Water with Polyurethane Foam Thin-Layer Spectrophotometry,
W89-00482 5A

BISPHENOL A
Degradation of Bisphenol A in Natural Waters,
W89-00600 5B

BLEACHING WASTES
Methods for Determination of Sum Parameters and Characterization of Organochlorine Compounds in Spent Bleach Liquors from Pulp Mills and Water, Sediment and Biological Samples from Receiving Waters,
W89-00358 5A

Investigations of Chlorinated Thiophenes: A Group of Bioaccumulable Compounds Identified in the Effluents from Kraft Bleaching,
W89-00360 5B

High Molar Mass Lignin in Bleached Kraft Pulp Mill Effluents,
W89-00361 5A

Physiological Disturbances in Fish Exposed to Bleached Kraft Mill Effluents,
W89-00363 5C

Effects of a Bleached Pulp Mill Effluent on Growth and Gonad Function in Baltic Coastal Fish,
W89-00367 5C

Fate of Spent Bleach Liquor Material in Receiving Waters: Characterization of Chlororganics in Sediments,
W89-00371 5B

Biosorption of Organic Halide in a Kraft Mill Generated Lagoon,
W89-01138 5D

BLUE CRABS
Biochemical Composition of the Blue Crab Callinectes sapidus Exposed to the Water-Soluble Fraction of Crude Oil,
W89-00391 5C

BLUEGILL
Comparative Sensitivities of Bluegill, Channel Catfish and Fathead Minnow to pH and Aluminum,
W89-01098 5C

BOATS
Motor-Boat-Derived Volatile Organic Compounds (VOC) in Lake water,
W89-00499 5B

BODY SIZE
Body Size and Mass Flow in Freshwater Plankton: Models and Tests,
W89-00218 2H

BOGS
Development of Streamlined Bog Islands in the Continental Interior of North America,
W89-00434 2H

BOHAI SEA
Numerical Simulation on Typhoon Surge and Surge Estimation of Huanghe River Estuary Region in Bohai Sea, (in Chinese),
W89-00543 2L

BOKROS BACKWATER
Seasonal Changes of Phytoplankton in the Backwater Bokros,
W89-00147 2H

BOLIVIA
Water Resources, Salinity and Salt Yields of the Rivers of the Bolivian Amazon,
W89-01213 2E

BOMBAY
Mercury Pollution in the Estuarine Region around Bombay Island,
W89-00638 5B

BOREHOLE GEOPHYSIC
General Correction for Spontaneous Potential Well Logs in Fresh Water,
W89-01195 7B

BORON
Boron Levels in Some Ground Waters of Halkidiki (A Land at Northern Aegean Sea),
W89-00569 5B

BOSTON HARBOR
Role of Economic Benefits Analysis in Funding Marine Combined Sewer Overflow Projects - Case Study of Boston Harbor,
W89-01132 6C

BOT RIVER ESTUARY
Geomorphology, Offshore Bathymetry and Quaternary Lithostratigraphy around the Bot River Estuary,
W89-00649 2L

Barrier/Estuarine Processes. Bot River Estuary: An Interpretation of Aerial Photographs,
W89-00650 2L

Bathymetry, Environmental Parameters and Sediments of the Bot River Estuary, S.W. Cape Province.
W89-00651 2L

Numerical Model for the Wind-Driven Circulation in the Bot River Estuary,
W89-00652 2L

Historical Records of the Bot River Estuarine System,
W89-00653 2L

Hydrology of the Bot River Estuary,
W89-00654 2L

Physical and Chemical Characteristics of the Waters of the Bot River Estuary, South Africa,
W89-00655 2L

Primary Productivity of the Bot River Estuary, South Africa,
W89-00656 2L

Effect of Salinity and Temperature Variations on the Bacterial Population in the Bot River Estuary,
W89-00657 2L

Annual Cycle of Free-Floating Bacteria in the Bot River Estuary,
W89-00658 2L

Zooplankton and Some Environmental Conditions in the Bot River Estuary,
W89-00659 2L

Benthic Macrofauna of the Bot River Estuary, South Africa, with a Note on Its Meiofauna,
W89-00660 2L

Variations in the Use of the Bot River Estuary by Water-Birds,
W89-00661 2L

Ecological Role of the Red-Knobbed Coot, Fulica cristata Gmelin, at the Bot River Estuary, South Africa: A Preliminary Investigation,
W89-00662 2L

Comparison of the Physiological Condition of the Southern Mullet Liza richardsoni (Smith), in a Closed Estuary and the Sea,
W89-00663 2L

Mass Mortality of Fish Associated with Low Salinity Conditions in the Bot River Estuary,
W89-00664 2L

Changes in the Fish Fauna of the Bot River Estuary in Relation to Opening and Closure of the Estuary Mouth,
W89-00665 2L

Synopsis of the Impact of Artificially Opening the Mouth of the Bot River Estuary: Implications for Management,
W89-00666 2L

BOTHNIAN SEA
Distribution of Chlorinated Organic Substances from Pulp Mills,
W89-00359 5B

BOTTOM SAMPLING
Is Water a Relevant Sampling Medium for Toxic Chemicals: An Alternative Environmental Sensing Strategy,
W89-01162 5A

BOTTOM SEDIMENTS
Suspended Matter and Bottom Deposits in the Mahury Estuarine System (French Guiana): Environmental Consequences,
W89-00003 2J

Influence of Sediment Composition and Irradiance on the Growth and Morphology of Myriophyllum spicatum L.,
W89-00098 2H

Chemical Characteristics of Bottom Sediment Top Layer in Szczytno Male Lake,
W89-00237 2H

Sorption of Cations by Bottom Sediments of Szczytno Male and Letowo Lakes, with Cage Trout Culture,
W89-00239 2H

Bathymetry, Environmental Parameters and Sediments of the Bot River Estuary, S.W. Cape Province.
W89-00651 2L

Contamination of Surface Sediments of the Principal Rivers of Geneva Canton by Polychlorinated Biphenyls and DDT (Contamination des Sediments Superficiels des Principales Rivieres du Canton de Geneve par les Polychlorobiphenyles et DDT),
W89-00690 5B

Comparison of Instream and Laboratory Methods of Measuring Sediment Oxygen Demand,
W89-00869 7B

BOUNDARY CONDITIONS
Air and Water Flow: I. Horizontal Flow with an Arbitrary Flux Boundary Condition,
W89-00347 2G

Air and Water Flow: II. Gravitational Flow with an Arbitrary Flux Boundary Condition,
W89-00348 2G

BRACKISH WATER
Phytoplankton Composition of Stagnant and Tidal Ecosystems in Relation to Salinity, Nutrients, Light and Turbulence,
W89-00001 2L

Faunas of Land-Locked Lagoons: Chance Differences and the Problems of Dispersal,
W89-00141 2L

Nitrogen Metabolism in the Brackish Lake Nakanoumi. III. Nitrification-Dentrification in Low Concentration of Dissolved Oxygen, (in Japanese),
W89-00769 2H

BRAZIL
Seasonal and Short-Term Fluctuations in the Zooplankton Community of Paranoa Reservoir, Brasilia, Federal District, Brazil (Flutuacoes Sazonais e de Curta Duracao na Comunidade Zooplanktonica do Lago Paranoa, Brasilia-DF, Brasil),
W89-00006 2H

Decomposition Rates of Allochthonous Material (Litter) in Lake Carioca - Rio Doce Forest Park - MG (Taxa de Decomposicao do Material Aloctone 'Litter' na Lagoa Carioca - Parque Florestal do Rio Doce - Minas Gerias),
W89-00007 2H

Nutrient Release Through Decomposition of Diplodon Delodontus Expansus (Mollusca, Bival-

via) and Some Considerations of its Effects on the Ecology of a Small Tropical Reservoir,
W89-00009 2H

Contribution of Spartina alterniflora to the Pedra de Guaratiba (RJ) Salt Marsh Sediment Using Carbon-13 as a Tracer (Contribuicao de Materia Organica de Spartina alterniflora Para o Sedimento do Alagado de Pedra de Guaratiba (RJ): Uso de C13 como Tracador),
W89-00010 2L

BREACHING

Hydrology of the Bot River Estuary,
W89-00654 2L

Changes in the Fish Fauna of the Bot River Estuary in Relation to Opening and Closure of the Estuary Mouth,
W89-00665 2L

Synopsis of the Impact of Artificially Opening the Mouth of the Bot River Estuary: Implications for Management,
W89-00666 2L

BRINES

Trace Metal Geochemistry of Pore Water Brines from Two Hypersaline Lakes,
W89-01079 2K

BRITISH COLUMBIA

Politics of Hydro-Megaprojects: Damming with Faint Praise in Australia, New Zealand, and British Columbia,
W89-00836 6E

BROMIDES

Trihalomethane Formation in High-Bromide Lake Galilee Water,
W89-00426 5F

Role of Soil Organic Matter in the Geochemical Cycling of Chloride and Bromide,
W89-01200 2A

BROMINE COMPOUNDS

Determination of Total Organic Chlorine and Bromine in Water Samples by Adsorption onto Activated Carbon and Neutron Activation Analysis,
W89-00588 5A

Polybrominated Biphenyl Ethers in Marine Fish, Shellfish, and River and Marine Sediments in Japan,
W89-00610 5B

BROWN WATER LAKES

Microbial Degradation of Xenobiotic, Aromatic Pollutants in Humic Water,
W89-00344 5B

BRYNICA RIVER

Chemical Mechanisms of Heavy Metal Transport in Waters of Mala Panew and Brynica Rivers (Silesia, Poland),
W89-00251 5B

BULKING SLUDGE

Bulking Control with Ozonation in a Nutrient Removal Activated Sludge System,
W89-00930 5D

Effect of Environmental Conditions on the Occurrence of Microthrix parvicella in Activated Sludge,
W89-01217 5D

BURROWING

Mud-Burrowing Megafauna of the Clyde Sea Area,
W89-00821 2L

CADMIUM

Concentrations of Trace Metals in the Qiantagnjiang River and its Estuary in Southern China,
W89-00443 5B

Removal of Cadmium using Chitosan,
W89-00496 5D

Distribution of Cadmium in Lake Tohya,
W89-00774 2H

Marine Pollution in Orkney,
W89-00796 5G

Use of Factorial Experimental Design to Evaluate How Biotic and Abiotic Factors Influence Cadmium Accumulation in the Unicellular Alga Dunaliella bioculata,
W89-01043 5B

Effects of Cadmium on Early Developmental Stages of the Sheepshead Minnow (Cyprinodon Variegatus),
W89-01091 5C

Metallothionein-Like Heavy Metal Binding Protein Levels in Asiatic Clams Are Dependent on the Duration and Mode of Exposure to Cadmium,
W89-01228 5B

CALCIUM

Ca(+2)-Stress, Biological Response and Particle Aggregation in the Aquatic Habitat,
W89-00669 2K

CALIBRATIONS

Assessing the Birkenes Model of Stream Acidification Using a Multisignal Calibration Methodology,
W89-00974 7B

CALIFORNIA

Nutrient and Light Limitation of Algae in Two Northern California Streams,
W89-00296 2H

Microhabitat Use by an Assemblage of California Stream Fishes: Developing Criteria for Instream Flow Determinations,
W89-00319 6D

Effects of Organic Contaminants on Reproduction of the Starry Flounder Platichthys stellatus in San Francisco Bay. I. Hepatic Contamination and Mixed-Function Oxidase (MFO) Activity During the Reproductive Season,
W89-00385 5C

Once and Future Experience of the California Coastal Conservancy,
W89-01067 6E

California Tahoe Conservancy: Applying the Principles,
W89-01068 6E

Wetland Projects of the California State Coastal Conservancy: An Assessment,
W89-01069 6E

Prospects for Transfer of the California Coastal Conservancy Model for Habitat Restoration to Other Coastal States,
W89-01070 6E

System for Coastal Description and Classification,
W89-01071 7C

Hydrogen Ion Concentration and Alkalinity of Reservoir Water in the Sierra Nevada, California, and Correlations with Air Pollutants,
W89-01165 5B

State Equitable Apportionment of Western Water Resources,
W89-01267 6E

CANADA

Characteristic Features of Supercooled Raindrops in the Mid-Winter Season of Arctic Canada,
W89-00418 2B

54 Hours of Continuous Post-Frontal Precipitation North of the Alpine Mountain Barrier, 22-25 August 1975,
W89-00464 2B

Adventures in Holistic Ecosystem Modelling: The Cumberland Basin Ecosystem Model,
W89-00675 2L

Organochlorines and Eggshell Thinning in Northern Gannets (Sula bassanus) from Eastern Canada, 1968-1984,
W89-01054 5C

Ecology of Freshwater Gastropods in the Central Canadian Region,
W89-01183 2H

Size Structure of Planktonic Crustaceans in a Dimictic Lake on the Canadian Shield (Structure en Taille des Crustaces Planctoniques d'un Lac Dimictique du Bouclier Canadien),
W89-01231 2H

CANAL DESIGN

50th Anniversary of the Moscow Canal,
W89-00049 8A

CANALS

Water-Management Significance of the Moscow Canal,
W89-00050 3B

Reliability and Safety Inspection of Hydraulic Structures of the Moscow Canal,
W89-00051 8A

Improvement of the Electrical Equipment and Control Systems to the Lock Mechanisms of the Moscow Canal,
W89-00052 8C

Hydraulic Tests for Reconstructing the Pumping Stations on the Moscow Canal,
W89-00055 8C

Calculation of Channel Deformations of Large Earth Canals with Damless Water Intake from Reservoirs,
W89-00553 8A

Stability of Sand Slopes in the Groundwater Discharge Zones,
W89-01174 8D

Capacity of Ice-Covered Canals,
W89-01177 8B

CANCER

Trace Element Content in Drinking Water of Nasopharyngeal Carcinoma Patients,
W89-00048 5C

CANNERIES

Liquid Effluents of the Fish Canning Industries of Rio de Janeiro State: Treatment Alternatives,
W89-00646 5D

CAPACITY

Funding Reserve Capacity in Wastewater Systems,
W89-00506 5D

Analytical Simulation of Water System Capacity Reliability: 2. A Markov Chain Approach and Verification of the Models,
W89-01241 5F

CAPILLARY CONDUCTIVITY

Contaminant Transport in Fractured Porous Media: Steady State Solutions by a Boundary Integral Method,
W89-00982 5B

CAPITAL COSTS
GAC Treatment Cost Experience at Two Drinking Water Utilities,
W89-00495 5F

CARBAMATE PESTICIDES
Toxicity Bioassay of Technical and Commercial Formulations of Carbaryl to the Freshwater Catfish, Clarias batrachus,
W89-00086 5C

CARBON
Tropical Wetlands as a Carbon Source,
W89-00118 2H

Carbon Source of the Water Soldier, Stratiotes aloides L.,
W89-00128 2H

CARBON CYCLE
Internal Elemental Cycles Affecting the Long-Term Alkalinity Status of Lakes: Implications for Lake Restoration,
W89-00016 5G

Tropical Wetlands as a Carbon Source,
W89-00118 2H

Diel and Seasonal Carbon Budgets in Two Cold Spring Ecosystems,
W89-00177 2H

Flux of Organic Carbon in a Tidal Salt Marsh, Kowie River Estuary, Port Alfred, South Africa,
W89-00453 2L

CARBON CYCLING
Dynamics of Protistan Carbon and Nutrient Cycling,
W89-00383 2L

CARBON DIOXIDE
Photosynthesis of Submersed Macrophytes in Acidified Lakes: II. Carbon Limitation and Utilization of Benthic CO2 Sources,
W89-00095 5C

Oxygen Budget of a River in Submerged Macrophytes (River Zschopau in the South of the GDR),
W89-00137 2H

Oxygen Transfer Through Flexible Tubing and Its Effects on Ground Water Sampling Results,
W89-00943 5A

CARBONATE ROCKS
Dry Stream Reaches in Carbonate Terranes: Surface Indicators of Ground-Water Reservoirs,
W89-00870 7B

Aragonite-to-Calcite Transformation During Fresh-Water Diagenesis of Carbonates: Insights from Pore-Water Chemistry,
W89-01076 2K

CARBONATES
Surface Reactions of Synthetic, End-member Analogues of Monazite, Xenotime and Rhabdophane, and Evolution of Natural Waters,
W89-01080 2K

Reactivity of the Carbonate Radical with Aniline Derivatives,
W89-01088 5B

CARCINOGENS
Tumor Frequencies and Contaminant Concentrations in Brown Bullheads from an Industrialized River and a Recreational Lake,
W89-00028 5C

Trace Element Content in Drinking Water of Nasopharyngeal Carcinoma Patients,
W89-00048 5C

Reactivity of the Carbonate Radical with Aniline Derivatives,
W89-01088 5B

CARMARTHEN BAY
Comparison of Nutrients in the Interstitial Water of Reducing (Tamar Estuary) and Oxic (Carmarthen Bay) Coastal Sediments,
W89-00156 2L

CARP
Acute Toxicity of Ammonia to Common Carp (Cyprinus carpio L.),
W89-00244 5C

Testing the Secondary Treatment of Effluents from the 'Police' Chemical Plant in Carp Ponds,
W89-00255 5D

Bioavailability of Polychlorinated Dibenzo-p-dioxins and Dibenzofurans from Contaminated Wisconsin River Sediment to Carp,
W89-00583 5B

CARSKA BARA SWAMP
Microbiological Examination of the Carska Bara Swamp Water,
W89-00146 2H

CATCHMENT AREAS
Effects of Acidification on Metal Budgets of Lakes and Catchments,
W89-00207 5C

Evaluating Peat-Mining Hydrology Using DRAINMOD,
W89-00755 4C

Drainage Basin Peak Discharge Rating Curve,
W89-00913 2E

Environmentally Sound River Engineering Examples from the Thames Catchment,
W89-00962 4A

Runoff Generation in a Low Arctic Drainage Basin,
W89-01207 2A

CATFISH
Toxicity Bioassay of Technical and Commercial Formulations of Carbaryl to the Freshwater Catfish, Clarias batrachus,
W89-00086 5C

Growth and Conversion Efficiency of the Catfish Heteropneustes fossilis (Bloch) Exposed to Sub-Lethal Concentrations of Sodium Pentachlorophenate,
W89-00243 5C

Relations Between Habitat Variables and Channel Catfish Populations in Prairie Streams,
W89-00325 2H

Influence of pH and Ammonia Salts on Ammonia Toxicity and Water Balance in Young Channel Catfish,
W89-00377 5C

CATIONS
Sorption of Cations by Bottom Sediments of Szczytno Male and Letowo Lakes, with Cage Trout Culture,
W89-00239 2H

Determination of Mono- and Divalent Cations and Anions in Small Fog Samples by Ion Chromatography,
W89-00372 5A

Sorption of Cationic Oligomers on Sediments,
W89-01094 5B

CATTAILS
Typha Productivity in a Texas Pond: Implications for Energy and Nutrient Dynamics in Freshwater Wetlands,
W89-00524 2H

CAVITATION
Simplified Turbine Runner Shows Good Cavitation Resistance,
W89-01003 8C

CELERITY
Regression Estimates for Topological-Hydrograph Input,
W89-00304 2E

CEMENTS
Effects of Three Organics on Selected Physical Properties of Type I Portland Cement,
W89-00994 5E

CENTRIFUGATION
Movement of Sludge through Conveyor Centrifuge,
W89-00485 5D

CESIUM RADIOISOTOPES
Chernobyl 134Cs, 137Cs, and 210Pb in High Mountain Lake Sediment: Measurements and Modeling of Mixing Process,
W89-00271 5B

CHANNEL CATFISH
Comparative Sensitivities of Bluegill, Channel Catfish and Fathead Minnow to pH and Aluminum,
W89-01098 5C

CHANNEL CONFLUENCES
Sediment Transport and Bed Morphology at River Channel Confluences,
W89-00411 2J

CHANNEL EROSION
Effect of Runoff Variability on Deformation of Erodible Channels near Structures,
W89-00072 2J

Alluvial Channel Hydraulics,
W89-01017 2J

CHANNEL FLOW
Regularities in the Formation of Curved Channels,
W89-00041 2J

Roles of Sedimentation and Plant Growth in Changing Flow Patterns in the Okavango Delta, Botswana,
W89-00457 2J

Flow Simulation Using Channel Network Model,
W89-00751 7B

CHANNEL MORPHOLOGY
Regularities in the Formation of Curved Channels,
W89-00041 2J

Sediment Transport and Bed Morphology at River Channel Confluences,
W89-00411 2J

Flow Regimes and Dynamic Equilibrium of Morphological Changes at Koycegiz Lake Inlet, Turkey,
W89-00449 8B

Calculation of Channel Deformations of Large Earth Canals with Damless Water Intake from Reservoirs,
W89-00553 8A

Tidal Asymmetry and Estuarine Morphology,
W89-00670 2L

Scour Channel Development after Spillway Failure,
W89-00897 2J

Channel Change and Sediment Transport in Regulated U.K. Rivers,
W89-00958 2J

Hydrological Heterogeneity Catchment Morphology and Catchment Response,
W89-01024 2A

CHANNEL SCOUR
Scour Channel Development after Spillway Failure,
W89-00897 2J

CHANNELING
Environmentally Sound River Engineering Examples from the Thames Catchment,
W89-00962 4A

CHANNELS
Dynamics of Saltwater Intrusion in Coastal Channels,
W89-00833 2L

CHELATING AGENTS
Influence of Selected Organic Complexing Agents on the Sorption of Heavy Metals in River Sediments (Einfluss Ausgewaehlter Organischer Komplexbildner auf die Sorption von Schwermetallen an Gewaessersedimente),
W89-00501 5B

CHELATION
Solubilities of Trace Copper and Lead Species and the Complexing Capacity of River Water in the Linggi River Basin,
W89-00084 5B

CHEMICAL ANALYSIS
Continuous-flow System for the Determination of Cobalt in Sea and River Water: In-line Preconcentration/Separation Coupled with Catalytic Determination,
W89-00063 5A

Determination of Organic Matter in River Sediments,
W89-00169 7B

Catalytic Determination of Copper in Natural Water at Microgram/L Level by Flow Injection Analysis, (in Chinese),
W89-00201 7B

Determination of Naphthenic Acids in California Crudes and Refinery Wastewaters by Fluoride Ion Chemical Ionization Mass Spectrometry,
W89-00209 5A

Instrumentation for 7-Day Continuous Cycle Monitoring of Metals with Automated On-Line Sample Preparation, High-Performance Liquid Chromatography, and Electrochemical Detection,
W89-00210 5A

Analysis of ppb Levels of Organics in Water by Means of Purge-and-Trap, Capillary Gas Chromatography and Selective Detectors,
W89-00288 5A

Determination of Mono- and Divalent Cations and Anions in Small Fog Samples by Ion Chromatography,
W89-00372 5A

Determination of Trace Chromium in Natural Water by Polarographic Catalytic Wave Analysis, (in Chinese),
W89-00538 5A

Extraction and Determination of Chlorophyll from Benthic Green Algae with Dimethyl Sulfoxide, (in Chinese),
W89-00539 7B

Sequential Extraction of Phosphorus and Heavy Metals from Sediments: Methodological Considerations,
W89-00629 5A

Effects of Aquatic Humic Substances on Analysis for Hydrogen Peroxide Using Peroxidase-Catalyzed Oxidations of Triarylmethanes or p-Hydroxyphenylacetic Acid,
W89-00634 7B

Comparison of Methods for the Determination of Chlorophyll in Estuarine Sediments,
W89-00668 2L

Phosphorus Determination in Rivers (Phosphor in Fliessgewaessern und Seine Analytische Bestimmung),
W89-00735 5A

Determination of Substituted Aromatic Amines in Water and Sediment Samples,
W89-00738 5A

Determination of Organotins in Natural Waters by Toluene Extraction and Graphite Furnace AAS,
W89-00743 5A

Chemistry and Delta 13C of Total Dissolved Carbon in Waters of Selected Springs Nearby Lublin City: Weekly Observations from October 1982 to June 1983,
W89-00895 2F

Oxygen Transfer Through Flexible Tubing and Its Effects on Ground Water Sampling Results,
W89-00943 5A

Precipitation and Indirect Spectrophotometric Determination of Sulfate Traces in Fresh Water with Lead Nitrate and Tetraphenylporphine Trisulfonic Acid,
W89-01085 5A

Gas Chromatographic-Mass Spectrometric Investigations on Lipophilic Anthropogenic Substances in Environmental Samples. II: A Splitter for the Simultaneous Detection of Capillary Gas Chromatograms by up to Four Different GC-Detectors,
W89-01086 5A

CHEMICAL COAGULATION
Factors Affecting Coagulation with Aluminum Sulfate: I. Particle Formation and Growth,
W89-01221 5F

Factors Affecting Coagulation with Aluminum Sulfate: II. Dissolved Organic Matter Removal,
W89-01222 5F

CHEMICAL DEGRADATION
Degradation and Formation of Refractory DOM by Bacteria During Simultaneous Growth on Labile Substrates and Persistent Lake Water Constituents,
W89-00691 2H

Degradation of Polycyclic Aromatic Hydrocarbons: III. Reaction Products of the Ozonolysis of Further Polycyclic Aromatic Hydrocarbons in Aqueous Systems (Zum Abbau von Polycyclischen Aromatischen Kohlenwasserstoffen: III. Reaktionsprodukte der Umsetzung von Weiteren Polycyclischen Aromatischen Kohlenwasserstoffen in Wasser mit Ozon),
W89-00739 5F

CHEMICAL PRECIPITATION
Simultaneous Removal of Heavy Metal Ions from Wastewater by Foam Separation Techniques,
W89-00265 5D

Iron Oxide Formation in Artificial Ground Waters,
W89-00687 2F

CHEMICAL PROPERTIES
Internal Elemental Cycles Affecting the Long-Term Alkalinity Status of Lakes: Implications for Lake Restoration,
W89-00016 5G

Determination of Gross-Beta Radioactivity in Water of the Changjiang River and Sea Water Near Its Entrance to Sea, (in Chinese),
W89-00534 2H

Application of the Principle of Least Sigma to the Chemical Model of Natural Water, (in Chinese),
W89-00537 2H

Partitioning of Organochlorines Between Water, Particulate Matter and Some Organisms in Estuarine and Marine Systems of the Netherlands,
W89-00672 5B

Can the Redox Conditions in Natural Waters be Predicted by a Single Parameter,
W89-00688 2K

Interpretation and Measurement of Redox Intensity in Natural Waters: A Comment to T. Frevert's Paper, 'Can the Redox Conditions in Natural Waters be Predicted by a Single Parameter',
W89-00689 2K

Chemistry and Delta 13C of Total Dissolved Carbon in Waters of Selected Springs Nearby Lublin City: Weekly Observations from October 1982 to June 1983,
W89-00895 2F

Multisignal Automatic Calibration Methodology for Hydrochemical Models: A Case Study of the Birkenes Model,
W89-00973 5B

CHEMICAL REACTIONS
Interpretation and Measurement of Redox Intensity in Natural Waters: A Comment to T. Frevert's Paper, 'Can the Redox Conditions in Natural Waters be Predicted by a Single Parameter',
W89-00689 2K

Transmission Electron Microscopic Study of Solidified/Stabilized Organics,
W89-01000 5E

Surface Reactions of Synthetic, End-member Analogues of Monazite, Xenotime and Rhabdophane, and Evolution of Natural Waters,
W89-01080 2K

CHEMICAL SPECIATION
Aluminum Speciation in Surface Waters from a Welsh Upland Area,
W89-01055 5B

CHEMICAL TREATMENT
Simultaneous Removal of Heavy Metal Ions from Wastewater by Foam Separation Techniques,
W89-00265 5D

Efficacy of Chemical Dosing Methods for Isolating Nontuberculous Mycobacteria from Water Supplies of Dialysis Centers,
W89-00343 5A

Central Softening by Crystallization in a Fluidized-Bed Process,
W89-00421 5F

Treatability Studies of Textile Wastewater,
W89-00627 5D

Liquid Effluents of the Fish Canning Industries of Rio de Janeiro State: Treatment Alternatives,
W89-00646 5D

Lake Treatment with Alum,
W89-00745 5G

Microporous Filters with Oxidizing Power for Iron and Manganese Removal from Water,
W89-00889 5F

CHEMICAL WASTES
Simultaneous Gas Chromatographic Determination of Nitrobenzene and 2,4-Dinitrophenol in Nitrobenzene Manufacturing Plant Wastewater,
W89-00479 5A

CHEMICAL WASTEWATER
Testing the Secondary Treatment of Effluents from the 'Police' Chemical Plant in Carp Ponds,
W89-00255 5D

In situ Adapation of Activated Sludge by Shock Loading to Enhance Treatment of High Ammonia Content Petrochemical Wastewater,
W89-01127 5D

CHEMISTRY OF PRECIPITATION
Chemistry of Atmospheric Precipitation in the Babia Gora National Park,
W89-00082 5B

Changes in Rainwater Acidity Associated with Closure of a Copper Smelter,
W89-00272 5B

Field Study of the Cloud Chemistry and Cloud Microphysics at Great Dun Fell,
W89-00308 5B

Seasonal and Temporal Changes of Organic Compounds in Rain and Snow,
W89-00429 5B

Rain-Aerosol Coupling in Urban Area: Scavenging Ratio Measurement and Identification of Some Transfer Processes,
W89-00430 2B

Atmospheric Deposition of Arsenic and Association with Acid Precipitation,
W89-00431 5B

Comparisons of RADM and Oscar Precipitation Chemistry Data,
W89-00433 5B

Evaluation of the Sulfur(IV) Catalyzed Autoxidation of Cobalt(II) in an Azide Containing Medium as a Means for the Determination of Sulfite in Precipitation,
W89-00736 5A

Wet Deposition of Ammonium in Europe,
W89-00765 2B

Influence of Altitude on Rainfall Composition at Great Dun Fell,
W89-01146 5B

Influence of Altitude on Wet Deposition: Comparison between Field Measurements at Great Dun Fell and the Predictions of a Seeder-Feeder Model,
W89-01147 5B

Occurrence and Distribution of Trace Organic Compounds in Bermuda Precipitation,
W89-01148 5B

Dissolution of Trace Metals from Particles of Industrial Origin and Its Influence on the Composition of Rainwater,
W89-01149 5B

Aerosol and Hydrometeor Concentrations and Their Chemical Composition during Winter Precipitation along a Mountain Slope: I. Temporal Evolution of the Aerosol, Microphysical and Meteorological Conditions,
W89-01150 2B

CHERNOBYL ACCIDENT
Chernobyl 134Cs, 137Cs, and 210Pb in High Mountain Lake Sediment: Measurements and Modeling of Mixing Process,
W89-00271 5B

Investigation of Transport-Processes along the Elbe River Using Chernobyl Radionuclides as Tracers,
W89-00636 5B

CHESAPEAKE BAY
Clearance of Bacteria-Sized Particles by Natural Populations of Nanoplankton in the Chesapeake Bay Outflow Plume,
W89-01032 2L

Interjurisdictional Management in Chesapeake Bay Fisheries,
W89-01073 6E

CHIGNECTO BAY
Nutrient Dynamics in Cumberland Basin - Chignecto Bay, A Turbid Macrotidal Estuary in the Bay of Fundy, Canada,
W89-00152 2L

CHINA
Chemical Behavior of Metal Elements in the Sediments in the Hanjiang River Estuary and Shantou Port, (in Chinese),
W89-00202 2L

Distribution of Agglutinated Foraminifera in Bottom Sediments of the Zhujiang River Estuary, (in Chinese),
W89-00203 2L

Concentrations of Trace Metals in the Qiantagnjiang River and its Estuary in Southern China,
W89-00443 5B

Analysis and Assessment of Water Quantities in Lakes of China, (In Chinese),
W89-00531 2H

Hydrological Features of Poyang Lake (II), (in Chinese),
W89-00535 2H

Probing into the Computation Method on Sedimentary Amount of Poyang Lake, (in Chinese),
W89-00540 2H

Numerical Simulation on Typhoon Surge and Surge Estimation of Huanghe River Estuary Region in Bohai Sea, (in Chinese),
W89-00543 2L

Studies on Marine Humic Substances: IV. The Distribution of Humic Substances in the Seawater and Sediments of Huanghe River Estuary, (in Chinese),
W89-00545 2L

Dongjiang: A 500 MW Hydro Plant for Hunan Province,
W89-01001 8C

Intensive Hydro Development of the Hongshui River,
W89-01002 8C

China's Experience with Underground Works,
W89-01007 8H

RO Desalination in Northwest China,
W89-01065 3A

Preliminary Plan for Membrane Desalination in China,
W89-01066 3A

Composite Method for Estimating Annual Actual Evapotranspiration,
W89-01141 2D

Identification of a Multiple Input, Single Output, Linear, Time Invariant Model for Hydrological Forecasting,
W89-01209 7C

CHITIN
Distribution of Chitinolytic Bacteria in Various Aquatic Systems: A Comparative Study,
W89-00402 2H

CHITOSAN
Removal of Cadmium using Chitosan,
W89-00496 5D

CHLORELLA
Limits of Growth of Five Chlorella Species in the Presence of Toxic Heavy Metals,
W89-00191 5C

CHLORIDES
Role of Soil Organic Matter in the Geochemical Cycling of Chloride and Bromide,
W89-01200 2A

CHLORINATED COMPOUNDS
Emissions of Chlorinated Organics from a Municipal Sewage Sludge Burning Incinerator,
W89-00607 5B

CHLORINATED HYDROCARBONS
Microbial Degradation of Xenobiotic, Aromatic Pollutants in Humic Water,
W89-00344 5B

Methods for Determination of Sum Parameters and Characterization of Organochlorine Compounds in Spent Bleach Liquors from Pulp Mills and Water, Sediment and Biological Samples from Receiving Waters,
W89-00358 5A

Distribution of Chlorinated Organic Substances from Pulp Mills,
W89-00359 5B

Investigations of Chlorinated Thiophenes: A Group of Bioaccumulable Compounds Identified in the Effluents from Kraft Bleaching,
W89-00360 5B

Organochlorine Compounds in the Environment,
W89-00368 5C

Environmental Fate of Chloroguaiacols and Chlorocatechols,
W89-00369 5B

Fate of Spent Bleach Liquor Material in Receiving Waters: Characterization of Chloroorganics in Sediments,
W89-00371 5B

Seasonal and Temporal Changes of Organic Compounds in Rain and Snow,
W89-00429 5B

Head-Space Analysis of Readily Volatile Chlorinated Hydrocarbons in Air and Water (Head-Space-Analytik Leichtfluechtiger Chlorkohlenwasserstoffe in Luft und Wasser),
W89-00504 5A

Transient Liver Pathology in Patients Consuming Water from a Private Well Contaminated by PCBs from a Submersible Water Pump,
W89-00558 5C

Ecological Parameter of Surface Water in Northeastern Greece,
W89-00564 5B

Sedimentation of 74 PCB Congeners in the Upper Hudson River,
W89-00584 5B

Determination of Polychlorinated Dibenzofurans in Surface Water by Means of Liquid Chromatography Using on-Line Sample Preconcentration and Different Spectroscopic Detection Techniques,
W89-00590 5A

Age to PCB Concentration Relationship with the Striped Bass (Morone saxatilis) in the Hudson River and Long Island Sound,
W89-00597 5B

Routine Determination of Polychlorinated Biphenyl Residues in Fish and Shellfish in Taipei County,
W89-00605 5A

Investigation of the Production of Lipophilic Volatile Organohalogen Materials during Laboratory Chlorination of some Ground Water Samples from Yugoslavia,
W89-00608 5F

Polychlorinated Biphenyls in the Kupa River, Croatia, Yugoslavia,
W89-00609 5B

Polybrominated Biphenyl Ethers in Marine Fish, Shellfish, and River and Marine Sediments in Japan,
W89-00610 5B

Chlorinated Hydrocarbons in Sediments of the Elbe River and the Elbe Estuary,
W89-00614 5B

Contaminant Concentrations and Toxicity of Sea-Surface Microlayer Near Los Angeles, California,
W89-00857 5C

Sensitivity of Four Monitoring Well Sampling Systems to Low Concentration of Three Volatile Organics,
W89-00944 5A

Organochlorines and Eggshell Thinning in Northern Gannets (Sula bassanus) from Eastern Canada, 1968-1984,
W89-01054 5C

Organochlorine and Mercury Residues in Wild Mink and Otter: Comparison with Fish,
W89-01093 5B

CHLORINATED HYDROCARBONS
***SUSPENDED SEDIMENTS**

River Ems: Processes Affecting the Behaviour of Metals and Organochlorines during Estuarine Mixing,
W89-00149 5B

CHLORINATION

Controlling Swampy Odors in Drinking Water,
W89-00425 5F

Effect of Permanganate Oxidation and Chlorination on the Mutagenic Activity and other Quality Parameters of Artificially Recharged Ground Water Processed from Humus-rich Surface Water,
W89-00599 5F

Investigation of the Production of Lipophilic Volatile Organohalogen Materials during Laboratory Chlorination of some Ground Water Samples from Yugoslavia,
W89-00608 5F

Micromixing and Dispersion in Chlorine Contact Chambers,
W89-00622 5D

Chloropicrin in Potable Water: Conditions of Formation and Production during Treatment Processes (La Chloropicrine dans les Eaux Potables: Conditions de Formation et Evolution le long des Filieres de Traitement),
W89-00635 5F

CHLORINE COMPOUNDS

Determination of Total Organic Chlorine and Bromine in Water Samples by Adsorption onto Activated Carbon and Neutron Activation Analysis,
W89-00588 5A

CHLOROPHYLL

Hypolimnetic Chlorophyll Maximum by Algae and Sulphur Bacteria in one Eutrophic Pond,
W89-00012 2H

Use of Plant Micro-Nutrient and Chlorophyll Records as Indices of Eutrophication in Inshore Waters,
W89-00160 5A

Summer Dynamics of the Deep Chlorophyll Maximum in Lake Tahoe,
W89-00224 2H

Clouds, Deep Chlorophyll Maxima and the Nutrient Supply to the Mixed Layer of Stratified Water Bodies,
W89-00227 2L

Extraction and Determination of Chlorophyll from Benthic Green Algae with Dimethyl Sulfoxide, (in Chinese),
W89-00539 7B

Comparison of Methods for the Determination of Chlorophyll in Estuarine Sediments,
W89-00668 2L

Sampling Strategies and Associated Errors in Estimating Epilimnetic Chlorophyll in Eutrophic Lakes,
W89-01242 2H

CHLOROPHYLL A

Changes in Chlorophyll Contents of Swietokrzyskie Lake Phytoplankton, as Related to Qualitative and Quantitative Fluctuations of Phytoplankton Density and of the Physicochemical Conditions in this Lake in Summer 1979,
W89-00257 5C

Chlorophyll Relationships in Letowo and Szczytno Male Lakes, with Trout Cage Culture,
W89-00262 2H

Algal Studies of the River Ely, South Wales, U.K.: II. Epilithic Algae,
W89-00679 2H

Studies on Epilithic and Epiphytic Diatoms in a Chalkstream: Comparative Estimates of Chlorophyll a and Its Derivatives,
W89-01186 2H

Lake Response Modeling Using Biologically Available Phosphorus,
W89-01236 5C

CHLOROPHYTA

Effect of 3,4 Benzopyrene on the Photosynthetic and Respiratory Intensity of the Green Alga Scenedesmus quadricauda (Der Einfluss von 3,4-Benzpyren aud die Photosynthese- une Respirationsintensitat der Gruenalge Scenedesmus quadricauda),
W89-00135 5C

Diatoms and Other Algae from the Thermal-Sulphur Springs of Triponzo (Central Italy),
W89-00190 2H

Extraction and Determination of Chlorophyll from Benthic Green Algae with Dimethyl Sulfoxide, (in Chinese),
W89-00539 7B

CHLOROPICRIN

Chloropicrin in Potable Water: Conditions of Formation and Production during Treatment Processes (La Chloropicrine dans les Eaux Potables: Conditions de Formation et Evolution le long des Filieres de Traitement),
W89-00635 5F

CHROMATOGRAPHY

Instrumentation for 7-Day Continuous Cycle Monitoring of Metals with Automated On-Line Sample Preparation, High-Performance Liquid Chromatography, and Electrochemical Detection,
W89-00210 5A

Determination of Mono- and Divalent Cations and Anions in Small Fog Samples by Ion Chromatography,
W89-00372 5A

Purge and Trap Analysis of Aqueous Samples with Cryofocusing,
W89-00446 5A

Sediment-Water Partition Coefficients and HPLC Retention Factors of Aromatic Hydrocarbons,
W89-00560 5B

Application of Headspace Gas Chromatography to the Monitoring of Organic Substances in Industrial Effluent,
W89-00572 5A

Analysis of Atrazine in Underground Waters at Part Per Trillion Levels as an Early Warning Method for Contamination and for Soil Distribution Studies,
W89-00596 5A

Evaluation of Disposable Membrane Filter Units for Sorptive Losses and Sample Contamination,
W89-00623 5A

Gas Chromatographic-Mass Spectrometric Investigations on Lipophilic Anthropogenic Substances in Environmental Samples. II: A Splitter for the Simultaneous Detection of Capillary Gas Chromatograms by up to Four Different GC-Detectors,
W89-01086 5A

Estimating Soil/Sediment Partition Coefficients for Organic Compounds by High Performance Reverse Phase Liquid Chromatography,
W89-01223 5B

CHROMIUM

Chromium Removal from Water by Three Species of Duckweeds,
W89-00109 5D

Chromium Trace Determination in Inorganic, Organic and Aqueous Samples with Isotope Dilution Mass Spectrometry (Chromspurenbestimmungen in Anorganischen, Organischen und wa-Brigen Proben mit der Massenspektrometrischen Isotopenverdunnungsanalyse),
W89-00268 5A

Concentrations of Trace Metals in the Qiantagnjiang River and its Estuary in Southern China,
W89-00443 5B

Determination of Trace Chromium in Natural Water by Polarographic Catalytic Wave Analysis, (in Chinese),
W89-00538 5A

Chromium Speciation in the Huanghe River and Its Estuarine Region, (in Chinese),
W89-00544 5B

Removal of Chrome Dye from Carpet Effluents Using Coal: I,
W89-00630 5D

CHROMIUM

Copper, Nickel, and Chrome Recovery in a Jobshop to Eliminate Waste Treatment and Sludge Disposal,
W89-00993 5D

CLADOCERA

Primary Studies on Population Dynamics of 3 Species of Cladocera (Waterflea) in Dianshan Lake, (in Chinese),
W89-00198 2H

CLADOCERANS

Zooplankton Population of Man-Made Lakes in Abruzzi's Appennines: Campotosto Lake (Popolamento Zooplanctonico di un Lago di Sbarramento Dell'Appennino Abruzzese: Il Lago di Campotosto),
W89-00197 2H

CLAMS

Mercury in Freshwater Fish and Clams from the Cerro Prieto Geothermal Field of Baja California, Mexico,
W89-01153 5B

Metallothionein-Like Heavy Metal Binding Protein Levels in Asiatic Clams Are Dependent on the Duration and Mode of Exposure to Cadmium,
W89-01228 5B

CLASSIFICATION

Rating System for a Utility Rehabilitation Program,
W89-00467 6A

CLAYS

Use of Clay Soils in the Construction of Cutoff Curtains,
W89-00549 8D

Procedure for Evaluating Municipal Solid Waste Leachate Components Capable of Causing Volume Shrinkage in Compacted Clay Soils,
W89-00621 5E

Empirical Correlation for Estimating Pressure Drop Across Clogged Filters,
W89-00924 5F

Hydrogeology of Two Saskatchewan Tills. I. Fractures, Bulk Permeability, and Spatial Variability of Downward Flow,
W89-01201 2F

CLEAN AIR ACT

Clean Air Act-Transboundary Acid Rain Pollution Abatement-Administrative Discretion Citizen Suit,
W89-00839 5G

CLEAN WATER ACT

Restoration of Wetlands under Section 404 of the Clean Water Act: An Analytical Synthesis of Statutory and Case Law Principles,
W89-01189 6E

CLEANUP OPERATIONS

Nonaqueous Phase Liquid Transport and Cleanup: I. Analysis of Mechanisms,
W89-00968 5B

Nonaqueous Phase Liquid Transport and Cleanup: II. Experimental Studies,
W89-00969 5B

Analytical Solution for Aquifer Decontamination by Pumping,
W89-00977 5G

Design Criteria for In-Situ and On-Site Renovation of an Industrial Sludge Lagoon,
W89-00996 5B

CLEAR-CUTTING

Effect of Logging and Regeneration on Groundwater, Streamflow and Stream Salinity in the Southern Forest of Western Australia,
W89-00350 4C

CLIMATIC CHANGES

Repercussions of a CO2 Doubling on the Water Cycle and on the Water Balance - A Case Study for Belgium,
W89-00355 2A

CLIMATOLOGY

Winter Diurnal Trends of Sierra Nevada Supercooled Liquid Water and Precipitation,
W89-00089 3B

Climatography of Thunder Events in the Conterminous United States: Part I: Temporal Aspects,
W89-00274 2B

Climatography of Thunder Events in the Conterminous United States: Part II: Spatial Aspects,
W89-00275 2B

El Nino-Southern Oscillation and Rainfall Variability,
W89-00276 2B

Influence of an Arctic Large-Lakes System on Mesoclimate in South-Central Baffin Island, N.W.T., Canada,
W89-00437 2H

Other Forms of Environmental Pollution,
W89-00794 5B

Climate of the Estuary and Firth of Clyde,
W89-00800 2L

Interannual Variability in Climate and Fisheries in Tasmania,
W89-00847 2A

Macrohydrology: The New Challenge for Process Hydrology,
W89-01012 2A

Vertically Integrated Snow/Ice Model over Land/Sea for Climate Models: 1. Development,
W89-01260 2C

Vertically Integrated Snow/Ice Model over Land/Sea for Climate Models: 2. Impact on Orbital Change Experiments,
W89-01261 2C

Comparison of Model-Generated and Satellite-derived Cloud Cover and Radiation Budget,
W89-01262 2A

CLOGGING

Empirical Correlation for Estimating Pressure Drop Across Clogged Filters,
W89-00924 5F

CLOUD COVER

Comparison of Model-Generated and Satellite-derived Cloud Cover and Radiation Budget,
W89-01262 2A

CLOUD LIQUID WATER

Liquid Cloudwater Collection Using Modified Mohnen Slotted Rods,
W89-00764 7B

CLOUD SEEDING

Secondary Ice Nucleus Generation by Silver Iodide Applied to the Ground,
W89-00088 3B

Persistent Effects of Cloud Seeding with Silver Iodide,
W89-00091 3B

Enhancement of Runoff From a Small Watershed by Cloud Seeding,
W89-01212 3B

CLOUD WATER

Winter Cloud Water and Air Composition in Central Ontario,
W89-01265 5C

CLOUDS

Winter Diurnal Trends of Sierra Nevada Supercooled Liquid Water and Precipitation,
W89-00089 3B

Field Study of the Cloud Chemistry and Cloud Microphysics at Great Dun Fell,
W89-00308 5B

Relationship Between delta-D and delta-18-O Values of Falling Snow Particles from a Separate Cloud,
W89-00406 2C

Life Cycle Effects of Cloud Clusters on the Moisture Distribution over the Eastern Atlantic,
W89-00417 2B

Liquid Cloudwater Collection Using Modified Mohnen Slotted Rods,
W89-00764 7B

Determining Microwave Brightness Temperatures from Precipitating Horizontally Finite and Vertically Structured Clouds,
W89-01263 7B

CLOUDS COVER

Clouds, Deep Chlorophyll Maxima and the Nutrient Supply to the Mixed Layer of Stratified Water Bodies,
W89-00227 2L

CLYDE ESTUARY

Geography of the Estuary and Firth of Clyde,
W89-00798 2L

Geological and Geomorphological Setting of the Estuary and Firth of Clyde,
W89-00799 2L

Climate of the Estuary and Firth of Clyde,
W89-00800 2L

Fresh Water Inflows to the Firth of Clyde,
W89-00801 2L

Clyde Sea Hydrography,
W89-00802 2L

Water Movement and the Simulation of Storm Surges in the Firth of Clyde,
W89-00803 2L

Effluent Disposal and the Physical Environment,
W89-00804 5E

Bioturbation, Microbial Activity and Sediment Properties in an Estuarine Ecosystem,
W89-00806 2L

Attached Algae of the Clyde and Garnock Estuaries,
W89-00807 5C

Epilithic Diatoms of the Clyde Estuary,
W89-00808 2L

Status of Fish Populations in the Clyde Estuary,
W89-00809 2L

Recent Changes in Numbers of Waders on the Clyde Estuary, and Their Significance for Conservation,
W89-00810 5C

Patterns of Association Between Birds and Invertebrates in the Clyde Estuary,
W89-00811 2L

Seasonal Studies on the Phytoplankton and Primary Production in the Inner Firth of Clyde,
W89-00812 2L

Phytoplankton Ecology of the Firth of Clyde Sea-Lochs Striven and Fyne,
W89-00813 2L

Zooplankton Investigations in the Firth of Clyde,
W89-00814 2L

Ecology of Macroalgae in the Firth of Clyde,
W89-00815 2L

Seaweed-Associated Animal Communities in the Firth of Clyde, with Special Reference to the Population Biology of the Amphipod Hyale nilssoni (Rathke),
W89-00816 2L

Long-Term Changes in Some Benthic Species in the Firth of Clyde, with Particular Reference to Tellina tenuis da Costa,
W89-00817 5C

Benthic Fauna of Sandy Bays, with Particular Reference to Irvine Bay,
W89-00819 5C

Benthos of the Deeper Sediments of the Firth of Clyde, with Particular Reference to Organic Enrichment,
W89-00820 5C

Mud-Burrowing Megafauna of the Clyde Sea Area,
W89-00821 2L

Population Dynamics of Seabirds in the Firth of Clyde,
W89-00822 2L

Trace Metals in the Common Mussel Mytilus edulis (L.) in the Clyde Estuary,
W89-00823 5B

Use of the Clyde Estuary and Firth for the Disposal of Effluents,
W89-00824 5E

Biology and Management of Herring and Other Pelagic Fish Stocks in the Firth of Clyde,
W89-00825 2L

Recent Changes in the Status of Some Clyde Vertebrates,
W89-00826 5C

Conservation of Natural Resources,
W89-00827 6E

Migratory Salmonids of the Estuary and Firth of Clyde,
W89-00828 5G

Distribution of Plaice Eggs and Larvae in the Clyde Sea Area,
W89-00829 2L

Saltmarshes of the Firth of Clyde,
W89-00830 2L

CLYDE SEA

Hydrography of Irvine Bay and Its Relation to the Clyde Sea Area,
W89-00805 2L

COAGULATION

Using Moringa Seeds as Coagulants in Developing Countries,
W89-00420 5F

Treatability Studies of Textile Wastewater,
W89-00627 5D

Factors Affecting Coagulation with Aluminum Sulfate: I. Particle Formation and Growth,
W89-01221 5F

Factors Affecting Coagulation with Aluminum Sulfate: II. Dissolved Organic Matter Removal,
W89-01222 5F

COAL

Removal of Chrome Dye from Carpet Effluents Using Coal: I,
W89-00630 5D

COAL ASH

Effect of pH and Contact Time on the Concentration of As(III) and As(V) in Coal Ash Systems,
W89-00624 5E

COAL LIQUID

Avoidance of a Water-Soluble Fraction of Coal Liquid by Fathead Minnows,
W89-00321 5C

COASTAL AQUIFERS

Validity of the Environmental Chloride Method for Recharge Evaluation of Coastal Aquifers, India.
W89-00356 7B

New Approximate Technique for the Hodograph Method in Groundwater Flow and Its Application to Coastal Aquifers,
W89-01243 2F

COASTAL MANAGEMENT

Assessing Networked Coastal Zone Management Programs,
W89-00290 6B

Wetland Projects of the California State Coastal Conservancy: An Assessment,
W89-01069 6E

COASTAL WATER

Faunas of Land-Locked Lagoons: Chance Differences and the Problems of Dispersal,
W89-00141 2L

COASTAL WATERS

Availability of Phosphorus Sources for Blooms of Phaeocystis pouchetii (Haptophyceae) in the North Sea: Impact of the River Rhine,
W89-00004 2L

Loss of Seagrass in Cockburn Sound, Western Australia: II. Possible Causes of Seagrass Decline,
W89-00116 5C

Monitoring of Mercury Pollution in Dutch Coastal Waters by Means of the Teleostean Fish Zoarces Viviparus,
W89-00150 5C

Modelling Research on the Production Cycle of Phytoplankton in the Southern Bight of the North Sea in Relation to Riverborne Nutrient Loads,
W89-00157 2L

Nitrogen Dynamics in Lower Narragansett Bay: II. Phytoplankton Uptake, Depletion Rates of Nitrogenous Nutrient Pools, and Estimates of Ecosystem Remineralization,
W89-00215 2L

Sediment-Water Core Sampler for Coastal Pollution Studies,
W89-00641 5A

Diurnal Changes of pH Distribution and the Cascading of Shore Water in a Sargassum Forest,
W89-00682 2L

Coastal Topography of the Moray Firth,
W89-00775 2L

Nature Conservation in the Moray Firth,
W89-00776 2L

Coastal Planning in the Moray Firth,
W89-00777 2L

Hydrography and Plankton of the Moray Firth,
W89-00778 2L

Exploited Fish and Shellfish Species in the Moray Firth,
W89-00779 2L

Intertidal Macrofauna of Nigg Bay,
W89-00780 2L

Moray Firth Marine Fouling Communities,
W89-00781 2L

Comparison of the Fauna Retained On 0.5 mm and 1.0 mm Meshes from Benthic Samples Taken in the Beatrice Oilfield, Moray Firth, Scotland,
W89-00783 2L

Sub-Littoral Fauna of the Inverness, Cromarty and Dornoch Firths,
W89-00784 2L

Regulation of Pollution: Controls and Responsibilities,
W89-00786 6E

Water Quality in the Inverness and Beauly Firths,
W89-00789 5B

Development of Mass Blooms of Photosynthetic Bacteria on Sheltered Beaches in Scapa Flow, Orkney Islands,
W89-00795 2L

Marine Pollution in Orkney,
W89-00796 5G

Sea and Fresh Waters,
W89-00797 2L

Clyde Sea Hydrography,
W89-00802 2L

Zooplankton Investigations in the Firth of Clyde,
W89-00814 2L

Long-Term Changes in Some Benthic Species in the Firth of Clyde, with Particular Reference to Tellina tenuis da Costa,
W89-00817 5C

Benthic Fauna of Sandy Bays, with Particular Reference to Irvine Bay,
W89-00819 5C

Conservation of Natural Resources,
W89-00827 6E

Dynamics of Saltwater Intrusion in Coastal Channels,
W89-00833 2L

Community Structure of Zooplankton in Eastern Hudson Bay,
W89-01232 2L

COASTAL ZONE MANAGEMENT

Once and Future Experience of the California Coastal Conservancy,
W89-01067 6E

Prospects for Transfer of the California Coastal Conservancy Model for Habitat Restoration to Other Coastal States,
W89-01070 6E

System for Coastal Description and Classification,
W89-01071 7C

Coastal Management Issues for the Mouth of the River Murray, South Australia,
W89-01072 6E

Interjurisdictional Management in Chesapeake Bay Fisheries,
W89-01073 6E

COASTS
System for Coastal Description and Classification,
W89-01071 7C

COATINGS
Effective Coatings for Hydraulic Structures,
W89-00075 8G

COBALT
Continuous-flow System for the Determination of Cobalt in Sea and River Water: In-line Preconcentration/Separation Coupled with Catalytic Determination,
W89-00063 5A

Determination of Cobalt Ions in Natural Waters Using Differential Pulse Adsorptive Stripping Voltammetry,
W89-00480 5A

COGENERATION
Cogeneration Power Desalination Plants,
W89-01064 3A

COKE WASTES
MCRT for Control of Cokemaking Wastewater treatment,
W89-01139 5D

COLIFORMS
National Field Evaluation of a Defined Substrate Method for the Simultaneous Enumeration of Total Coliforms and Escherichia coli from Drinking Water: Comparison with the Standard Multiple Tube Fermentation Method,
W89-00337 5A

Incidence of Coliphage in Potable Water Supplies,
W89-00338 5F

Fecal Coliform Fingertip Count: A Potential Method for Evaluating the Effectiveness of Low Cost Water Supply and Sanitation Initiatives,
W89-00379 5G

Evaluating the Modifications to the MF Total Coliform Method for Drinking Water with High Noncoliform Backgrounds,
W89-00427 5A

Rapid Specific Environmental Coliform Monitoring,
W89-00445 5A

Rapid Detection of Total and Fecal Coliforms in Water by Enzymatic Hydrolysis of 4-Methylumbelliferone-beta-D-Galactoside,
W89-00734 5A

COLIPHAGE
Incidence of Coliphage in Potable Water Supplies,
W89-00338 5F

COLLOIDS
Reactor Accident at Chernobyl: A Possibility to Test Colloid-Controlled Transport of Radionuclides in a Shallow Aquifer,
W89-00990 5B

Solubility of Colloidal Ferric Hydroxide and its Relevance to Iron Concentrations in River Water,
W89-01081 2K

COLONIZATION
Pioneer Colonization and Interaction of Photosynthetic and Heterotrophic Microorganisms on an Artificial Substrate of Polyurethane Foam in E. J. Beck Lake, Illinois,
W89-00398 2H

COLOR REMOVAL
Treatment of Dye-Containing Effluents with Different Bentonites,
W89-00615 5D

COLORADO
Experimental Marvin Windshield Effects on Precipitation Records in Leadville, Colorado,
W89-00876 7B

COLORIMETRY
Determination of Phosphate at Low Concentrations in Surface Waters by Flow-Injection Analysis,
W89-00931 5A

COMBINED SEWERS OVERFLOWS
Role of Economic Benefits Analysis in Funding Marine Combined Sewer Overflow Projects - Case Study of Boston Harbor,
W89-01132 6C

COMMENCEMENT BAY
Hepatic Lesions in English Sole (Parophrys vetulus) from Commencement Bay, Washington (USA),
W89-00859 5C

COMPOSTING
Land Application of Domestic Wastewater, Wood Production, and Sludge Composting: An Economic and Energy Production Analysis,
W89-00465 5E

COMPRESSIVE STRENGTH
Effects of Three Organics on Selected Physical Properties of Type I Portland Cement,
W89-00994 5E

COMPUTER-AIDED DESIGN
Selection of a Method for Computer-aided Design of Earth Dams,
W89-00056 8D

COMPUTER APPLICATIONS
System for Coastal Description and Classification,
W89-01071 7C

COMPUTER MODELS
Selection of a Method for Computer-aided Design of Earth Dams,
W89-00056 8D

General Water Supply System Simulation Model: WASP,
W89-00299 5F

Application of Principal Component Analysis to Long-Term Reservoir Management,
W89-00698 6A

Basic Encoded Model for One-Dimensional Ground Water Systems Incorporating First-Order Degradation Kinetics,
W89-00888 5B

Composite Method for Estimating Annual Actual Evapotranspiration,
W89-01141 2D

COMPUTER PROGRAMS
Basic Encoded Model for One-Dimensional Ground Water Systems Incorporating First-Order Degradation Kinetics,
W89-00888 5B

STASOFT: A User-Friendly Interactive Computer Program for Softening and Stabilisation of Municipal Waters,
W89-00935 5F

General Correction for Spontaneous Potential Well Logs in Fresh Water,
W89-01195 7B

COMPUTERS
Water/Wastewater Facilities Get Better with Electronics,
W89-00392 5D

Satellite Data and Geographical Information System for Land Use Classification,
W89-00756 7B

Microcomputer-Based Measurement of Algal Fluorescence as a Potential Indicator of Environmental Contamination,
W89-01157 5A

CONCRETE CONSTRUCTION
Filterless Revetment of the Slopes of Dikes at Pumped-storage Station Reservoirs,
W89-00058 8A

CONCRETE TECHNOLOGY
Works of S. V. Shestoperov on Frost Resistance of Hydrotechnical Concrete,
W89-00061 8F

CONCRETE TESTING
Works of S. V. Shestoperov on Frost Resistance of Hydrotechnical Concrete,
W89-00061 8F

CONCRETES
Technology of Casting Precast Pipeline Elements of the Kaisiadory's Pumped-Storage Station,
W89-00045 8F

Effects of Three Organics on Selected Physical Properties of Type I Portland Cement,
W89-00994 5E

CONDUCTIVITY
Multiple Reflection and Attenuation of Time Domain Reflectometry Pulses: Theoretical Considerations of Applications to Soil and Water,
W89-00701 7B

Determination of Electrical Conductivity Using Time Domain Reflectometry: Soil and Water Experiments in Coaxial Lines,
W89-00702 2G

Charge Induced on a Conducting Cylinder by a Point Charge and Its Application to the Measurement of Charge on Precipitation,
W89-00762 7B

CONDUITS
Outlet Structure Design for Conduits and Tunnels,
W89-00307 8A

CONFIDENCE INTERVALS
Confidence Intervals for Flood Events Under a Pearson 3 or Log Pearson 3 Distribution,
W89-00879 7C

CONFINED AQUIFERS
Single-Well Tracing Method for Estimating Regional Advective Velocity in a Confined Aquifer: Theory and Preliminary Laboratory Verification,
W89-00707 2F

CONFLUENT STREAMS
Sediment Transport and Bed Morphology at River Channel Confluences,
W89-00411 2J

CONJUNCTIVE USE
River Regulation by Seasonal Groundwater Abstraction: The Case of the River Itchen,
W89-00956 4B

CONNECTICUT
Upgrading Water Systems through Planning,
W89-00746 6B

CONSERVATION
Nature Conservation in the Moray Firth,
W89-00776 2L

River Regulation and Nature Conservation,
W89-00961 4A

Once and Future Experience of the California Coastal Conservancy,
W89-01067 6E

California Tahoe Conservancy: Applying the Principles,
W89-01068 6E

Wetland Projects of the California State Coastal Conservancy: An Assessment,
W89-01069 6E

Prospects for Transfer of the California Coastal Conservancy Model for Habitat Restoration to Other Coastal States,
W89-01070 6E

CONSTRUCTION
Prospects of Improving the Prediction of the Hazard of Rock Bursts During Tunneling,
W89-00038 8E

Introduction of New Technology on the Construction of the Shamkhor Hydroelectric Station,
W89-00039 8A

Use of Horizontal Drainage for Draining Dam Slopes,
W89-00040 8C

Preservation of Natural Fish Reproduction during Hydrotechnical Construction on Rivers,
W89-00069 8I

Analysis of the Effects of Suspended Sediment of Huanghe River on Harbor Construction by Using NOAA Images, (in Chinese),
W89-00536 2J

Reconstruction of the Surge Tank of the Sengilei Hydroelectric Station,
W89-00546 8C

Calculation of Pressure Tunnel Linings with Consideration of Consolidation Grouting of the Rocks,
W89-00547 8C

Determination of the Mechanical Characteristics of Rocks by the Method of Volume Confinement of Deformations,
W89-00548 8E

Use of Clay Soils in the Construction of Cutoff Curtains,
W89-00549 8D

Experience in Determining the Numerical Characteristics of Landslide Movements,
W89-00551 8A

Modification of Turbine Runner Blades at the Chirkey Hydroelectric Station,
W89-00555 8C

New Pumped-Storage Station Designs,
W89-00556 8C

Estimation of the Reliability of Earth Dams with Consideration of Seismic Loads,
W89-00557 8E

London Water Ring Main,
W89-00840 5F

Tidal Power Ruffles Feathers,
W89-00850 8A

Dongjiang: A 500 MW Hydro Plant for Hunan Province,
W89-01001 8C

CONSTRUCTION EQUIPMENT
Excavation of Heavy Soils by Dredges,
W89-00068 8H

CONSTRUCTION MATERIALS
Deformation of Dams with a Facing and Their Seismic Stability,
W89-00070 8D

CONSTRUCTION METHODS
Excavation of Heavy Soils by Dredges,
W89-00068 8H

CONSUMPTIVE USE
Developing and Assessing a Model of Residential Water Conservation,
W89-00881 3D

CONTAMINATION
Evaluation of Disposable Membrane Filter Units for Sorptive Losses and Sample Contamination,
W89-00623 5A

Modeling Contaminant Propagation in Drinking Water Distribution Systems,
W89-00929 5F

CONTINUUM MODELS
Continuum Models for Contaminant Transport in Fractured Porous Formations,
W89-00966 5B

Continuum Approach for Modeling Mass Transport in Fractured Media,
W89-00980 5B

CONTRACTS
Selecting a Contract Operator for Your Water or Wastewater Facility,
W89-01100 5F

Drafting Purchase and Sale Agreements Affecting Water Rights,
W89-01252 6E

CONTROL SYSTEMS
Making the Right Moves in SCADA Selection,
W89-01103 5F

CONTROLLED STORAGE
Improving Canal Water Deliveries with Auxiliary Storage,
W89-00758 3B

CONVECTION
Microscale Haline Convection - A Proposed Mechanism for Transport and Mixing at the Water Table Region,
W89-00718 2F

CONVECTIVE PRECIPITATION
Modified ATI Technique for Nowcasting Convective Rain Volumes over Areas,
W89-00090 2B

Evolution and Fine Structure of a Long-Lived Meso-alpha-Scale Convective System in a Baiu Frontal Zone. Part II: Meso-gamma-Scale Characteristics of Precipitation,
W89-00416 2B

CONVEYANCE STRUCTURES
Automation of Conveyor Transport at the Construction Site of Earth Dams,
W89-01173 8H

COOLING PONDS
Adaptation of Phytoplankton-Degrading Microbial Communities to Thermal Reactor Effluent in a New Cooling Reservoir,
W89-00336 5C

COPEPODS
Zooplankton Population of Man-Made Lakes in Abruzzi's Appennines: Campotosto Lake (Popolamento Zooplanctonico di un Lago di Sbarramento Dell'Appennino Abruzzese: Il Lago di Campotosto),
W89-00197 2H

Tidal Transport of Planktonic Copepods across the Sill of a British Columbia Fjord,
W89-00221 2L

Biology of Harpacticoid Copepods in the Meiofauna of Shallow Subtidal Sands,
W89-00818 2L

Large-Scale and Long-Term Variations in the Zooplankton Community of the Gullmar Fjord, Sweden, in Relation to Advective Processes,
W89-01038 2L

Interspecific, Seasonal and Diel Variations in Zooplankton Trypsin and Amylase Activities in Kosterfjorden, Western Sweden,
W89-01040 2L

Pelagic Ecosystem Model Simulating Production and Sedimentation of Biogenic Particles: Role of Salps and Copepods,
W89-01041 2L

Discrimination between Algae and Artificial Particles by Freshwater and Marine Copepods,
W89-01047 2H

COPPER
Solubilities of Trace Copper and Lead Species and the Complexing Capacity of River Water in the Linggi River Basin,
W89-00084 5B

Catalytic Determination of Copper in Natural Water at Microgram/L Level by Flow Injection Analysis, (in Chinese),
W89-00201 7B

Corneal Damage in Larvae of Striped Bass Morone saxatilis Exposed to Copper,
W89-00380 5C

Concentrations of Trace Metals in the Qiantagnjiang River and its Estuary in Southern China,
W89-00443 5B

Size Distribution and Copper Association of Dissolved Organic Material in Urban Runoff,
W89-00628 5B

Speciation Studies of Copper and Magnesium in Duckweed Extract Using Interfaced HPLC and Thermospray Neubulizer Flame AA,
W89-00886 5D

Copper, Nickel, and Chrome Recovery in a Jobshop to Eliminate Waste Treatment and Sludge Disposal,
W89-00993 5D

Copper Binding by Dissolved Organic Matter: I. Suwannee River Fulvic Acid Equilibria,
W89-01077 5B

Copper Binding by Dissolved Organic Matter: II. Variation in Type and Source of Organic Matter,
W89-01078 5B

COPPER SULFATE
Uptake and Distribution of Copper Sulphate and Its Effect on the Respiration Rate of the Hemocyanin-Producing Freshwater Snail Lymnaea natalensis,
W89-01155 5G

CORALS
Sensitivity of Coral Reefs to Environmental Pollution,
W89-00440 5C

CORES
Sediment-Water Core Sampler for Coastal Pollution Studies,
W89-00641 5A

Simple, Reliable, and Inexpensive Pore-Water Sampler,
W89-01051 7B

CORN
Effects of Simulated Acidic Precipitation on Plant-Insect Interactions in Agricultural Systems: Corn and Black Cutworm Larvae,
W89-01160 5C

CORRELATION ANALYSIS
Parametric and Nonparametric Tests for Dependent Data,
W89-00864 7C

Empirical Correlation for Estimating Pressure Drop Across Clogged Filters,
W89-00924 5F

Statistical Correlations for Predicting the Partition Coefficient for Nonpolar Organic Contaminants Between Aquifer Organic Carbon and Water,
W89-00992 5B

Volume Fraction Correlation for Narcosis in Aquatic Organisms: The Key Role of Partitioning,
W89-01096 5C

Temporal Variability in Spatial Correlation of Daily Rainfall,
W89-01247 2B

CORROSION CONTROL
Evaluation of Chemical Oxidizers for Hydrogen Sulfide Control,
W89-01129 5D

COST ANALYSIS
Ex Post Analysis of Flood Control: Benefit-Cost Analysis and the Value of Information,
W89-00983 6C

Role of Economic Benefits Analysis in Funding Marine Combined Sewer Overflow Projects - Case Study of Boston Harbor,
W89-01132 6C

COST-BENEFIT ANALYSIS
Ex Post Analysis of Flood Control: Benefit-Cost Analysis and the Value of Information,
W89-00983 6C

Role of Economic Benefits Analysis in Funding Marine Combined Sewer Overflow Projects - Case Study of Boston Harbor,
W89-01132 6C

COSTS
Implications of Public Ownership of Irrigation Canal Systems in the Texas Rice Belt: Impacts on Water Use and Water Price,
W89-00460 6E

Diffuse (Nonpoint) Pollution - A Political, Institutional, and Fiscal Problem,
W89-01134 5G

CRABS
Dispersal and Recruitment of Fiddler Crab Larvae in the Delaware River Estuary,
W89-01039 2L

CREEP
Creep of Ice Measured with the Pressuremeter,
W89-00387 2C

CREOSOTE
Effects of High Levels of Polycyclic Aromatic Hydrocarbons on Sediment Physicochemical Properties and Benthic Organisms in a Polluted Stream,
W89-00589 5C

Creosote Compounds in Snails Obtained from Pensacola Bay, Florida, near an Onshore Hazardous-Waste Site,
W89-00611 5B

CRESOLS
Estimate of the Variability in Biotransformation Kinetics of Xenobiotics in Natural Waters by Aufwuchs Communities,
W89-00559 5B

CRITICAL FLOW
Size of the Concrete Part of a Combined Apron below Low-head Outlet Works,
W89-01175 8B

CROMARTY FIRTH
Hydrocarbon and Pollutant Levels in the Cromarty Firth,
W89-00791 5B

CROP PRODUCTION
Effects of Simulated Acidic Precipitation on Plant-Insect Interactions in Agricultural Systems: Corn and Black Cutworm Larvae,
W89-01160 5C

CROPLAND
Improving Canal Water Deliveries with Auxiliary Storage,
W89-00758 3B

CRUSTACEANS
Drift of Zooplankton in a Lake-Outlet (Glatt) in a Day-Night-Rhythm Depending from the Water Level,
W89-00025 2H

Community Grazing and the Regulation of In Situ Clearance and Feeding Rates of Planktonic Crustaceans in Lakes in the Kuokkel Area, Northern Sweden,
W89-00181 2H

Zooplankton Population of Man-Made Lakes in Abruzzi's Appennines: Campotosto Lake (Popolamento Zooplanctonico di un Lago di Sbarramento Dell'Appennino Abruzzese: Il Lago di Campotosto),
W89-00197 2H

Primary Studies on Population Dynamics of 3 Species of Cladocera (Waterflea) in Dianshan Lake, (in Chinese),
W89-00198 2H

Mud-Burrowing Megafauna of the Clyde Sea Area,
W89-00821 2L

Size Structure of Planktonic Crustaceans in a Dimictic Lake on the Canadian Shield (Structure en Taille des Crustaces Planctoniques d'un Lac Dimictique du Bouclier Canadien),
W89-01231 2H

CRYOLOGY
Creep of Ice Measured with the Pressuremeter,
W89-00387 2C

CRYSTALLIZATION
Central Softening by Crystallization in a Fluidized-Bed Process,
W89-00421 5F

Phosphorus Removal by Crystallization Using a Granular Activated Magnesia Clinker,
W89-01126 5D

CULTURING TECHNIQUES
Evaluating the Modifications to the MF Total Coliform Method for Drinking Water with High Noncoliform Backgrounds,
W89-00427 5A

Effect of Culture History on the Determination of Biodegradation Kinetics by Batch and Fed-Batch Techniques,
W89-00513 5D

Assessment of Selenium Toxicity in Algae Using Turbidostat Culture,
W89-01230 5C

CULVERT FLOW
Flow Capacity of Culverts on Oregon Coast Range Forest Roads,
W89-00878 8B

CULVERTS
Flow Capacity of Culverts on Oregon Coast Range Forest Roads,
W89-00878 8B

CUMBERLAND BASIN
Nutrient Dynamics in Cumberland Basin - Chignecto Bay, A Turbid Macrotidal Estuary in the Bay of Fundy, Canada,
W89-00152 2L

Adventures in Holistic Ecosystem Modelling: The Cumberland Basin Ecosystem Model,
W89-00675 2L

CUMULATIVE RAINFALL
Multidimensional Modeling of Cumulative Rainfall: Parameter Estimation and Model Adequacy through a Continuum of Scales,
W89-00706 2B

CUTOFFS
Use of Clay Soils in the Construction of Cutoff Curtains,
W89-00549 8D

CYANIDE
Determination of Free Cyanide in Water by Released Fluorescence of a Dissociated Ternary Complex,
W89-00477 5A

Effects of Cyanide and Polyphosphates on Adsorption of Metals from Simulated and Real Mixed-Metal Plating Wastes,
W89-01219 5D

CYANOPHYTA
Heavy-Metal Toxicity in the Cyanobacterium Nostoc linckia,
W89-00094 5C

Animal Wastes Media for Spirulina Production,
W89-00136 5D

Benthic Cyanophyte Associations in Streams and Lakes (Benthische Cyanophyten-Gemeinschaften in Bachen und Seen),
W89-00184 2H

Physiological Ecology of Bluegreen Algal Mats (Modern Stromatolites) in Antarctic Oasis Lakes,
W89-00185 2H

Diatoms and Other Algae from the Thermal-Sulphur Springs of Triponzo (Central Italy),
W89-00190 2H

SEM-Analysis of Colonies of the Cyanophyte Nodularia Water Bloom from Baltic Sea,
W89-00193 2H

Effects of Increasing Salinity on a Cyanobacteria Bloom in the Potomac River Estuary,
W89-00231 2H

Photoexcretion and Fate of Glycolate in a Hot Spring Cyanobacterial Mat,
W89-00342 2H

Intermittent Destratification: A Therapy Measure against Cyanobacteria in Lakes,
W89-00639 5G

Myxococcal Predation on Cyanobacterial Populations: Nutrient Effects,
W89-01050 2H

CYCLING NUTRIENTS
Biomass Production and Nutrient Cycling in Aquatic Macrophyte Communities of the Chowan River, North Carolina,
W89-00097 2H

Nutrient Dynamics in Minerotrophic Peat Mires,
W89-00119 2H

Outwelling from Tropical Tidal Salt Flats,
W89-00140 2L

Nutrient Dynamics in Cumberland Basin - Chignecto Bay, A Turbid Macrotidal Estuary in the Bay of Fundy, Canada,
W89-00152 2L

Evaluation of Seasonal Nutrient Dynamics in the Oosterschelde (SW Netherlands),
W89-00153 2L

Factors Affecting Nutrient Dynamics in a Piedmont North Carolina Reservoir,
W89-00187 2H

Nutrient Levels and the Development of Diatom and Blue-Green Blooms in a Shallow Australian Estuary,
W89-00211 2H

Effect of Light Regime upon Growth Rate and Chemical Composition of a Clone of Skeletonema costatum from the Trondheimsfjord, Norway,
W89-00212 2L

Nitrogen Dynamics in Lower Narragansett Bay: II. Phytoplankton Uptake, Depletion Rates of Nitrogenous Nutrient Pools, and Estimates of Ecosystem Remineralization,
W89-00215 2L

Clouds, Deep Chlorophyll Maxima and the Nutrient Supply to the Mixed Layer of Stratified Water Bodies,
W89-00227 2L

Regeneration and Uptake of Ammonium by Plankton in an Amazon Floodplain Lake,
W89-00230 2H

Chemical Characteristics of Bottom Sediment Top Layer in Szczytno Male Lake,
W89-00237 2H

Nitrogen and Phosphorus Balance in Lake Szczytno Male,
W89-00240 2H

Concentrations of Nitrogen and Phosphorus in Waters of Two Hypertrophic Lakes and Their Effect on the Quantity of Phytoplankton Biomass,
W89-00245 2H

Diurnal Fluctuations of Phosphorus Forms in Lake Water and Seston in Pluss-See,
W89-00246 2H

Limnocorral Experiments in a Eutrophic Lake - Effects of Fish on the Planktonic and Chemical Conditions,
W89-00253 2H

Sorption Properties of Bottom Sediments of Szczytno Male and Letowo Lakes,
W89-00256 2H

Dynamics of Protistan Carbon and Nutrient Cycling,
W89-00383 2L

Productivity and Nutrient Cycling of Alaskan Tundra: Enhancement by Flowing Soil Water,
W89-00908 2G

CYCLONIC PRECIPITATION
Principal Component Analysis of Precipitation in the Adriatic-Pannonian Area of Yugoslavia,
W89-00472 2B

CZECHOSLOVAKIA
Radioactivity of the Czechoslovakian Reach of the Danube River (Die Radioaktivitat im tschechoslowakischen Donauabschnitt),
W89-00171 5B

DALLAS
Water Pollution Control in Dallas-Fort Worth,
W89-01233 5G

DAM CONSTRUCTION
Automation of Conveyor Transport at the Construction Site of Earth Dams,
W89-01173 8H

Characteristics of the Organization and Performance of Works in the Dam Foundation of the Al-Hadithah Hydro Development (Iraq),
W89-01182 8F

DAM DESIGN
Selection of a Method for Computer-aided Design of Earth Dams,
W89-00056 8D

Calculation of an Arch Dam on the Basis of Solving the Three-dimensional Problem of the Theory of Elasticity and Theory of Shells,
W89-00057 8A

DAM EFFECTS
Impact of Impounding on the Oxygen Balance of the Danube from Kelheim to Jochenstein Microbiological-Biochemical Investigations and Water Quality Model Calculations (Zum Einfluss der Strauregulierung auf den Sauerstoffhaushalt der Donaustrecke Kelheim-Jochenstein: Mikrobiologisch-biochemische Untersuchungen und Gutemodellrechnungen),
W89-00173 6G

Unionid (Mollusca:Bivalvia) Fauna of the Shenango River in Mercer County, Pennsylvania,
W89-00312 5C

Impact of River Regulations on Invertebrate Communities in the U.K.,
W89-00959 4A

DAM FAILURE
Formation and Failure of Natural Dams,
W89-00470 2J

Scour Channel Development after Spillway Failure,
W89-00897 2J

DAM FOUNDATIONS
Concerning Certain Studies on Seepage and Dissolution of Salts in the Foundation of Dams,
W89-00062 10C

Components of Forces of a Reservoir Acting on the Foundation of High Dams,
W89-00073 8B

Characteristics of the Organization and Performance of Works in the Dam Foundation of the Al-Hadithah Hydro Development (Iraq),
W89-01182 8F

DAM STABILITY
Deformation of Dams with a Facing and Their Seismic Stability,
W89-00070 8D

Components of Forces of a Reservoir Acting on the Foundation of High Dams,
W89-00073 8B

Hydrodynamic-Stiffness Matrix Based on Boundary Elements for Time-Domain Dam-Reservoir-Soil Analysis,
W89-00447 8B

DAMS
Assignment of the Characteristics of Clay-Rubble Soils in Watertight Components of Earth Dams,
W89-00036 8D

Improvement of the Effectiveness of Spillway Operation of High-Head Hydroelectric Stations,
W89-00067 8B

Deformation of Dams with a Facing and Their Seismic Stability,
W89-00070 8D

Components of Forces of a Reservoir Acting on the Foundation of High Dams,
W89-00073 8B

Hydrodynamic-Stiffness Matrix Based on Boundary Elements for Time-Domain Dam-Reservoir-Soil Analysis,
W89-00447 8B

Formation and Failure of Natural Dams,
W89-00470 2J

Experience in Operating Hydraulic Structures and Equipment of Hydroelectric Stations,
W89-00554 8C

Estimation of the Reliability of Earth Dams with Consideration of Seismic Loads,
W89-00557 8E

Politics of Hydro-Megaprojects: Damming with Faint Praise in Australia, New Zealand, and British Columbia,
W89-00836 6E

River Regulation in the United Kingdom: An Historical Perspective,
W89-00949 4A

Dongjiang: A 500 MW Hydro Plant for Hunan Province,
W89-01001 8C

Intensive Hydro Development of the Hongshui River,
W89-01002 8C

Characteristics of the Organization and Performance of Works in the Dam Foundation of the Al-Hadithah Hydro Development (Iraq),
W89-01182 8F

Lightning Spurs Hydro Rehab,
W89-01255 8C

DANUBE RIVER
Some Hydrochemical, Hydrobiological, and Ichthyological Features of Yugoslav Part of the Danube Lasting for Several Years (Einige hydrochemische, hydrobiologische und ichthyologische Eigenschaften der jugoslawischen Donaustrecke in mehrjahrigem Zeitraum),
W89-00165 5C

Viral Pollution of Surface Waters by Domestic Waste Water Discharge (Die Viral-Verunreinigung der Oberflachengewasser durch Ableiten der Haushaltsabwasser),
W89-00170 5B

Radioactivity of the Czechoslovakian Reach of the Danube River (Die Radioaktivitat im tschechoslowakischen Donauabschnitt),
W89-00171 5B

Phytoplankton Studies of Slowly Running Waters: Rivers Danube and Vils (Phytoplank-

tonstudien an langamfliessenden Gewassern: Donau und Vils),
W89-00172 2E

Impact of Impounding on the Oxygen Balance of the Danube from Kelheim to Jochenstein Microbiological-Biochemical Investigations and Water Quality Model Calculations (Zum Einfluss der Strauregulierung auf den Sauerstoffhaushalt der Donaustrecke Kelheim-Jochenstein: Mikrobiologisch-biochemische Untersuchungen und Gutemodellrechnungen),
W89-00173 6G

Detection and Enumeration of Actinomycetes in the Austrian Part of the Danube by Means of Selective Membrane Filtration Methods Together With Some Other Bacteriological Parameters (Nachweis und Vorkommen von Actinomyceten in der osterreichischen Donau mittels selektiver Membranfilterverfahren, zusammen mit einigen anderen bakteriologischen Parametern),
W89-00174 5A

DAPHNIA

Recurrence of Daphnia rosea in Lake Tahoe: Analysis of a Population Pulse,
W89-00216 2H

Zooplankton Community Grazing in a Hypertrophic Lake (Hartbeespoort Dam, South Africa),
W89-00220 2H

Predictive Structure-Toxicity Model with Daphnia magna,
W89-00591 5C

DARTERS

Habitat Use of Two Darter Species in Glover River, Oklahoma,
W89-00396 2H

DATA ACQUISITION

Correlations between Salinity and Growth of the Seagrass Amphibolis antarctica (Labill.) Sonder & Aschers., in Shark Bay, Western Australia, Using a New Method for Measuring Production Rate,
W89-00102 2L

Experimental Marvin Windshield Effects on Precipitation Records in Leadville, Colorado,
W89-00876 7B

Macrohydrology: The New Challenge for Process Hydrology,
W89-01012 2A

Remote Sensing in Hydrology,
W89-01019 2A

Microcomputer-Based Measurement of Algal Fluorescence as a Potential Indicator of Environmental Contamination,
W89-01157 5A

DATA ACQUISITIONS

Satellite Data and Geographical Information System for Land Use Classification,
W89-00756 7B

DATA AQUISITION

Speciation Studies of Copper and Magnesium in Duckweed Extract Using Interfaced HPLC and Thermospray Neubulizer Flame AA,
W89-00886 5D

DATA COLLECTIONS

Rain Measurement by Raingage-Radar Combination: A Geostatistical Approach,
W89-00761 7B

Liquid Cloudwater Collection Using Modified Mohnen Slotted Rods,
W89-00764 7B

Modern Management Standards of Water Network Register (Criteres Modernes de Gestion du Cadastre des Reseaux d'Eau),
W89-00919 5F

System for Coastal Description and Classification,
W89-01071 7C

DATA INTERPRETATION

Statistical Considerations Associated with the Use of the Heterotrophic Activity Method for Estimating V sub max and K' for Aquatic Environments,
W89-00280 7C

Nonparametric Approaches to Environmental Impact Assessment,
W89-00861 7C

Statistical Methods and Sampling Design for Estimating Step Trends in Surface-Water Quality,
W89-00862 7A

Multivariate Nonparametric Tests for Trend in Water Quality,
W89-00863 7C

Parametric and Nonparametric Tests for Dependent Data,
W89-00864 7C

Tau-Like Test for Trend in the Presence of Multiple Censoring Points,
W89-00865 7C

Data Analysis of Water Quality Time Series in Lake Erie,
W89-00866 7C

Nonparametric Tests for Trend Detection in Water Quality Time Series,
W89-00867 7C

Trends in Lead Concentrations in Major U.S. Rivers and Their Relation to Historical Changes in Gasoline-Lead Consumption,
W89-00868 5B

Confidence Intervals for Flood Events Under a Pearson 3 or Log Pearson 3 Distribution,
W89-00879 7C

Landscape and Rainfall Indices for Prediction of Streamflow Similarities in the Hunter Valley, Australia,
W89-00972 2E

Influence of Altitude on Wet Deposition: Comparison between Field Measurements at Great Dun Fell and the Predictions of a Seeder-Feeder Model,
W89-01147 5B

Acidic Deposition Distribution and Episode Statistics from the MAP3S Network Database,
W89-01151 5B

DATA STORAGE RETRIEVAL

Modern Management Standards of Water Network Register (Criteres Modernes de Gestion du Cadastre des Reseaux d'Eau),
W89-00919 5F

DDE

Organochlorine and Mercury Residues in Wild Mink and Otter: Comparison with Fish,
W89-01093 5B

DDT

Contamination of Surface Sediments of the Principal Rivers of Geneva Canton by Polychlorinated Biphenyls and DDT (Contamination des Sediments Superficiels des Principales Rivieres du Canton de Geneve par les Polychlorobiphenyles et DDT),
W89-00690 5B

DEBRIS

Reduction of a Dolly Varden Population and Macrobenthos after Removal of Logging Debris,
W89-00322 4C

DECIDUOUS FORESTS

Prediction of Snowmelt Rates in a Deciduous Forest,
W89-01203 2C

DECISION-MAKING

Issues in Rule Base Development,
W89-00305 6A

Optimization of the Production and Pumping Costs of the Nice Water Network (Optimisation de la Production et des Pompages sur le Reseau d'Eau de Nice),
W89-00922 5F

Risk: A Key Water Policy Issue,
W89-01123 6D

DECISIONMAKING

Multicriterion Selection of Wastewater Management Alternatives,
W89-00300 5D

DECOMPOSING ORGANIC MATTER

Decomposition Rates of Allochthonous Material (Litter) in Lake Carioca - Rio Doce Forest Park - MG (Taxa de Decomposicao do Material Aloctone 'Litter' na Lagoa Carioca - Parque Florestal do Rio Doce - Minas Gerias),
W89-00007 2H

Nutrient Release Through Decomposition of Diplodon Delodontus Expansus (Mollusca, Bivalvia) and Some Considerations of its Effects on the Ecology of a Small Tropical Reservoir,
W89-00009 2H

Contribution of Spartina alterniflora to the Pedra de Guaratiba (RJ) Salt Marsh Sediment Using Carbon-13 as a Tracer (Contribuicao de Materia Organica de Spartina alterniflora Para o Sedimento do Alagado de Pedra de Guaratiba (RJ): Uso de C13 como Tracador),
W89-00010 2L

Effects of the Season and of Water Chemistry on the Decomposition of Nymphaea alba L.: Weight Loss and Pyrolysis Mass Spectrometry of the Particulate Matter,
W89-00096 2H

Estimation of Phytoplankton Biomass and Production, and Organic Matter Decomposition in Three Small Field-Ponds,
W89-00252 2H

Effect of Mangrove Humic-Like Substances on Biodegradation Rate of Detritus,
W89-00476 2L

DECOMPOSITION

Contribution of Spartina alterniflora to the Pedra de Guaratiba (RJ) Salt Marsh Sediment Using Carbon-13 as a Tracer (Contribuicao de Materia Organica de Spartina alterniflora Para o Sedimento do Alagado de Pedra de Guaratiba (RJ): Uso de C13 como Tracador),
W89-00010 2L

Effects of the Season and of Water Chemistry on the Decomposition of Nymphaea alba L.: Weight Loss and Pyrolysis Mass Spectrometry of the Particulate Matter,
W89-00096 2H

Sources and Fate of Detritus in the Shore Zone of Lakes,
W89-00121 2H

Decomposition of Roots of Three Plant Communities in a Dutch Salt Marsh,
W89-00527 2L

Decomposition in an Ombrotrophic Bog and a Minerotrophic Fen in Minnesota,
W89-00742 2H

DECONTAMINATION
Analytical Solution for Aquifer Decontamination by Pumping,
W89-00977 5G

DEFORMATION
Deformation of Dams with a Facing and Their Seismic Stability,
W89-00070 8D

Effect of Runoff Variability on Deformation of Erodible Channels near Structures,
W89-00072 2J

DEGRADATION
Biotic and Abiotic Degradation Rates of Methyl Parathion in Freshwater and Estuarine Water and Sediment Samples,
W89-00601 5B

Studies of the Oxidative Photoinduced Degradation of Silicones in the Aquatic Environment,
W89-00617 5B

Basic Encoded Model for One-Dimensional Ground Water Systems Incorporating First-Order Degradation Kinetics,
W89-00888 5B

Sorption and Degradation of Aldicarb and Its Oxidation Products in a Soil-Water Flow System as a Function of pH and Temperature,
W89-01164 5B

DEGRADATION PRODUCTS
Degradation of Polycyclic Aromatic Hydrocarbons: III. Reaction Products of the Ozonolysis of Further Polycyclic Aromatic Hydrocarbons in Aqueous Systems (Zum Abbau von Polycyclischen Aromatischen Kohlenwasserstoffen: III. Reaktionsprodukte der Umsetzung von Weiteren Polycyclischen Aromatischen Kohlenwasserstoffen in Wasser mit Ozon),
W89-00739 5F

DEHYDRATION
Influence of pH and Ammonia Salts on Ammonia Toxicity and Water Balance in Young Channel Catfish,
W89-00377 5C

DEICERS
State Program Solves County Salt Storage Problem,
W89-00466 5G

DELTAS
Phytoplankton Composition of Stagnant and Tidal Ecosystems in Relation to Salinity, Nutrients, Light and Turbulence,
W89-00001 2L

Interaction of Some Environmental Factors in the Danube Delta on the Delimitation of the Vital Space Occupied by the Reed, Mace Reed and Sedge Cenoses (Die Einwirkung einiger Umweltfaktoren des Donaudeltas auf die Abgrenzung des Lebensraumes von Schilf-, Rohrkolben- und Seggengesellschaften),
W89-00163 2H

Roles of Sedimentation and Plant Growth in Changing Flow Patterns in the Okavango Delta, Botswana,
W89-00457 2J

Dynamic Changes and Processes in the Mississippi River Delta,
W89-00469 2J

Basin Sedimentation and the Growth of Prograding Deltas,
W89-00832 2J

Records of Riverborne Turbidity Currents and Indications of Slope Failures in the Rhone Delta of Lake Geneva,
W89-01049 2J

Sediments in the Estuarine Environment of the Tigris/Euphrates Delta; Iraq; Arabian Gulf,
W89-01083 2L

DEMPSTER'S RULE
Dempster's Rule of Combination in Soil-Loss Prediction,
W89-00303 2J

DENDROCHRONOLOGY
Texas Drought History Reconstructed and Analyzed from 1698 to 1980,
W89-00273 2B

DENITRIFICATION
Nitrogen Budget of the Scheldt Hydrographical Basin,
W89-00155 5B

Nitrogen Metabolism in the Brackish Lake Nakanoumi. III. Nitrification-Dentrification in Low Concentration of Dissolved Oxygen, (in Japanese),
W89-00769 2H

Nitrate Removal from Water Supplies Using Biological Denitrification,
W89-01237 5F

DENMARK
Population Dynamics and Production of Chironomidae (Diptera) at 2 m depth in Lake Esrom, Denmark,
W89-00182 2H

DENSITY STRATIFICATION
Clouds, Deep Chlorophyll Maxima and the Nutrient Supply to the Mixed Layer of Stratified Water Bodies,
W89-00227 2L

Shear Instability in a Highly Stratified Estuary,
W89-00415 2L

Analysis of Turbulent Buoyant Jet in Density-Stratified Water,
W89-00491 5B

DEOXYRIBONUCLEIC ACID
Mechanisms of DNA Utilization by Estuarine Microbial Populations,
W89-00340 2L

DEPOSITION
Stokes Surfaces and the Effects of Near-Surface Groundwater-Table on Aeolian Deposition,
W89-00410 2J

Wet Deposition of Ammonium in Europe,
W89-00765 2B

Basin Sedimentation and the Growth of Prograding Deltas,
W89-00832 2J

Chemical Evolution of a Travertine-Depositing Stream: Geochemical Processes and Mass Transfer Reactions,
W89-01250 2K

Aspects of Atmospheric Pollutant Origin and Deposition Revealed by Multielemental Observations at a Rural Location in Eastern Canada,
W89-01264 5B

DESALINATION
Experiments on Seawater Desalination by Membrane Distillation,
W89-01063 3A

RO Desalination in Northwest China,
W89-01065 3A

Preliminary Plan for Membrane Desalination in China,
W89-01066 3A

DESALINATION PLANTS
Cogeneration Power Desalination Plants,
W89-01064 3A

DESIGN CRITERIA
Use of Horizontal Drainage for Draining Dam Slopes,
W89-00040 8C

Flow Capacity of Culverts on Oregon Coast Range Forest Roads,
W89-00878 8B

Dongjiang: A 500 MW Hydro Plant for Hunan Province,
W89-01001 8C

Intensive Hydro Development of the Hongshui River,
W89-01002 8C

Complex Geology Leads to an Unusual Design for the Lakhwar Dam,
W89-01005 8E

New Measure of Interdependence Among Several Pollutants,
W89-01131 5D

DESIGN STANDARDS
Outlet Structure Design for Conduits and Tunnels,
W89-00307 8A

DESTRATIFICATION
Experiences of Long-term Destratification in a Water Supply Impoundment in Central Illinois,
W89-00403 5G

Mixing of Temperature-Stratified Lakes and Reservoirs by Buoyant Jets,
W89-00492 5G

Intermittent Destratification: A Therapy Measure against Cyanobacteria in Lakes,
W89-00639 5G

DETECTION LIMITS
Tau-Like Test for Trend in the Presence of Multiple Censoring Points,
W89-00865 7C

DETENTION RESERVOIRS
Effectiveness of an Urban Runoff Detention Pond-Wetlands System,
W89-00487 5G

Alternative Strategies for Stormwater Detention,
W89-00875 4A

DETERGENTS
Toxicity of an Anionic Detergent to the Spawn and Larvae of Anurans (Amphibia),
W89-00139 5C

Review of the Behaviour and Utilization of Polycarboxylic Acids as Detergent Builders,
W89-00620 5D

Nitrilotriacetic Acid (NTA) Environmental Monitoring Program in Indiana: 1979 to 1983,
W89-01089 5A

Studies on the Degradation of Synthetic Detergents by Sewage,
W89-01159 5B

DETRITUS
Sources and Fate of Detritus in the Shore Zone of Lakes,
W89-00121 2H

Effect of Mangrove Humic-Like Substances on Biodegradation Rate of Detritus,
W89-00476 2L

Effects of a Simulated Acid Precipitation on Leaf Litter Quality and the Growth of a Detritivore in a Buffered Lotic System,
W89-01058 5C

DETROIT
Comparison of Three Sediment Bioassay Methods Using Detroit River Sediments,
W89-01097 5A

DEUTERIUM
Relationship Between delta-D and delta-18-O Values of Falling Snow Particles from a Separate Cloud,
W89-00406 2C

DEVELOPING COUNTRIES
Using Moringa Seeds as Coagulants in Developing Countries,
W89-00420 5F

Package Water Treatment Facilities for Refugee Communities,
W89-00841 5F

Water Supply and Sanitation - Cornerstones of the World Health Organization's Forty Years of International Health Development,
W89-00917 5F

DEWATERING
Compressible Cake Filtration: Monitoring Cake Formation and Shrinkage Using Synchrotron X-rays,
W89-00512 5D

DIAGENESIS
Interactions Between Groundwater Seepage and Sediment Porewater Sulphate Concentration Profiles in Lake Anna, Virginia,
W89-00910 5B

Aragonite-to-Calcite Transformation During Fresh-Water Diagenesis of Carbonates: Insights from Pore-Water Chemistry,
W89-01076 2K

DIALYSIS CENTERS
Efficacy of Chemical Dosing Methods for Isolating Nontuberculous Mycobacteria from Water Supplies of Dialysis Centers,
W89-00343 5A

DIANCHI LAKE
Characteristics of Distribution and Migration of Phosphorus in Deposits of Dianchi Lake, (in Chinese),
W89-00200 5B

DIANSHAN LAKE
Primary Studies on Population Dynamics of 3 Species of Cladocera (Waterflea) in Dianshan Lake, (in Chinese),
W89-00198 2H

DIATOMS
Scanning Electron Microscopy of Bacteria and Diatoms Attached to a Submerged Macrophyte in an Increasingly Polluted Stream,
W89-00132 5C

Examination of the Connection Between the Patchiness of Benthic Nutrient Efflux and Epiphytobenthos Patchiness on Intertidal Flats,
W89-00161 2L

Diatoms and Other Algae from the Thermal-Sulphur Springs of Triponzo (Central Italy),
W89-00190 2H

Periphyton Diatom Communities and Trophic States of Three Shallow Lakes in the Pfynwald Region of Canton Valais, Switzerland,
W89-00195 2H

Nutrient Levels and the Development of Diatom and Blue-Green Blooms in a Shallow Australian Estuary,
W89-00211 2H

PCB-resistant Diatoms in the Hudson River Estuary,
W89-00284 5C

Water Column Productivity Attributable to Displaced Benthic Diatoms in Well-Mixed Shallow Estuaries,
W89-00297 2L

Algal Studies of the River Ely, South Wales, U.K.: II. Epilithic Algae,
W89-00679 2H

Effects of Current Velocity on the Physical Structuring of Diatom (Bacillariophyceae) Communities,
W89-00686 2E

Epilithic Diatoms of the Clyde Estuary,
W89-00808 2L

Induced Resistance to Polychlorinated Biphenyls Confers Cross-Resistance and Altered Environmental Fitness in a Marine Diatom,
W89-00860 5C

Studies on Epilithic and Epiphytic Diatoms in a Chalkstream: Comparative Estimates of Chlorophyll a and Its Derivatives,
W89-01186 2H

DIEGO GARCIA
Development and Management of Groundwater Resources on Diego Garcia,
W89-00423 4B

DIELECTRIC PROPERTIES
Multiple Reflection and Attenuation of Time Domain Reflectometry Pulses: Theoretical Considerations of Applications to Soil and Water,
W89-00701 7B

Determination of Electrical Conductivity Using Time Domain Reflectometry: Soil and Water Experiments in Coaxial Lines,
W89-00702 2G

DIFFERENTIAL EQUATIONS
Probing into the Computation Method on Sedimentary Amount of Poyang Lake, (in Chinese),
W89-00540 2H

DIFFERENTIAL PULSE ADSORPTIVE STRIPPING VOLTAMMETRY
Determination of Cobalt Ions in Natural Waters Using Differential Pulse Adsorptive Stripping Voltammetry,
W89-00480 5A

DIFFUSION
Dispersion in Heterogeneous Porous Media: 1. Local Volume Averaging and Large-Scale Averaging,
W89-00699 5B

Dispersion in Heterogeneous Porous Media: 2. Predictions for Stratified and Two-Dimensional Spatially Periodic Systems,
W89-00700 5B

DIKES
Filterless Revetment of the Slopes of Dikes at Pumped-storage Station Reservoirs,
W89-00058 8A

Role of Marsh Plants in the Transport of Nutrients as Shown by a Quantitative Model for the Freshwater Section of the Elbe Estuary,
W89-00120 2L

DIMENSIONAL ANALYSIS
Steady Unsaturated Seepage above a Sloping Impermeable Base,
W89-00726 2G

DIMICTIC LAKES
Size Structure of Planktonic Crustaceans in a Dimictic Lake on the Canadian Shield (Structure en Taille des Crustaces Planctoniques d'un Lac Dimictique du Bouclier Canadien),
W89-01231 2H

DIOXINS
Bioavailability of Polychlorinated Dibenzo-p-dioxins and Dibenzofurans from Contaminated Wisconsin River Sediment to Carp,
W89-00583 5B

Long-term Study of Ecosystem Contamination with 2,3,7,8-Tetrachlorodibenzo-p-dioxin,
W89-00603 5B

Monitoring of PCDDs in Osaka Bay Using Blue Mussel,
W89-00604 5B

Destruction of Polychlorinated Dibenzo-p-Dioxins and Dibenzofurans in Contaminated Water Samples Using Ozone,
W89-00606 5D

Emissions of Chlorinated Organics from a Municipal Sewage Sludge Burning Incinerator,
W89-00607 5B

DISCHARGE CAPACITY
Capacity of Ice-Covered Canals,
W89-01177 8B

DISCHARGE HYDROGRAPHS
Drainage Basin Peak Discharge Rating Curve,
W89-00913 2E

DISCHARGE MEASUREMENTS
Ultrasonic Flowmeter for Testing Units of Large Hydroelectric and Pumped-Storage Stations,
W89-01181 8C

DISCHARGE PERMITS
Cost Efficiency of Transferable Discharge Permit Markets for Control of Multiple Pollutants,
W89-00697 5G

DISEASES
Guinea Worm Disease in Northern Uganda: A Major Public Health Problem Controllable Through an Effective Water Programme,
W89-00278 5F

DISINFECTION
Effects of Discontinuing Disinfection on a Receiving Water,
W89-00515 5D

Effect of Permanganate Oxidation and Chlorination on the Mutagenic Activity and other Quality Parameters of Artificially Recharged Ground Water Processed from Humus-rich Surface Water,
W89-00599 5F

Micromixing and Dispersion in Chlorine Contact Chambers,
W89-00622 5D

High Level Disinfection of Wastewaters for Reuse,
W89-00642 5D

Characterization of the Interaction Between Viruses and a Solid Polymeric Contact Disinfectant,
W89-00884 5F

Ozone-Induced Particle Destabilization,
W89-01120 5F

DISPERSION
Dispersion in Heterogeneous Porous Media: 1. Local Volume Averaging and Large-Scale Averaging,
W89-00699 5B

Dispersion in Heterogeneous Porous Media: 2. Predictions for Stratified and Two-Dimensional Spatially Periodic Systems,
W89-00700 5B

DISSOLVED OXYGEN
Changes in Chlorophyll Contents of Swietokrzyskie Lake Phytoplankton, as Related to Qualitative and Quantitative Fluctuations of Phytoplankton Density and of the Physicochemical Conditions in this Lake in Summer 1979,
W89-00257 5C

Qualitative and Quantitative Changes in Phytoplankton on the Background of Physicochemical Changes in the Water of Swietokrzyskie Lake in the Years 1977-1979,
W89-00258 5C

Simple and Efficient New Design of the Submersible Stirrer for the YSI Dissolved Oxygen Meter,
W89-00936 7B

Kinetics of Sulfide Oxidation by Dissolved Oxygen,
W89-01130 5D

DISSOLVED SOLIDS
Size Distribution and Copper Association of Dissolved Organic Material in Urban Runoff,
W89-00628 5B

Degradation and Formation of Refractory DOM by Bacteria During Simultaneous Growth on Labile Substrates and Persistent Lake Water Constituents,
W89-00691 2H

Copper Binding by Dissolved Organic Matter: II. Variation in Type and Source of Organic Matter,
W89-01078 5B

Factors Affecting Coagulation with Aluminum Sulfate: II. Dissolved Organic Matter Removal,
W89-01222 5F

DISTILLATION
Experiments on Seawater Desalination by Membrane Distillation,
W89-01063 3A

DISTRICT OF COLUMBIA
Interjurisdictional Management in Chesapeake Bay Fisheries,
W89-01073 6E

DITCHES
Some Biological Aspects of Liza abu (Heckel) mugilidae, in AL-Daoodi Drain, (Baghdad, Iraq),
W89-00890 2H

DIURNAL DISTRIBUTION
Diurnal Distribution and Behavioral Responses of Fishes to Extreme Hypoxia in an Amazon Floodplain Lake,
W89-00331 2H

Diurnal Changes of pH Distribution and the Cascading of Shore Water in a Sargassum Forest,
W89-00682 2L

Interspecific, Seasonal and Diel Variations in Zooplankton Trypsin and Amylase Activities in Kosterfjorden, Western Sweden,
W89-01040 2L

DIVERSION
Experiences With the Assessment of the Residual Water Flow in Regulated Water Courses in the Salzburg Region (Erfahrungen bei der Beurteilung der Restwasserfuhrung von Ausleitungsstrecken im Land Salzburg),
W89-00164 4A

DIVERSION STRUCTURES
Risk Analysis for Fish Diversion Experiments: Pumped Intake Systems,
W89-00318 8I

DOCUMENTATION
Set of Documents for Overhauling RO400-960-11 Turbines of the Inguri Hydroelectric Station,
W89-00060 8C

DOLLY VARDEN
Reduction of a Dolly Varden Population and Macrobenthos after Removal of Logging Debris,
W89-00322 4C

Effects of Stream Cleaning on Juvenile Coho Salmon and Dolly Varden in Southeast Alaska,
W89-00374 2H

DOMESTIC WASTES
Effects of a Cyperus papyrus L. Swamp on Domestic Waste Water,
W89-00107 5D

Land Application of Domestic Wastewater, Wood Production, and Sludge Composting: An Economic and Energy Production Analysis,
W89-00465 5E

Shallowly Placed, Low Pressure Distribution System to Treat Domestic Wastewater in Soils with Fluctuating High Water Tables,
W89-01171 5D

Effect of Environmental Conditions on the Occurrence of Microthrix parvicella in Activated Sludge,
W89-01217 5D

DOMESTIC WATER
Effects of Rate Structure Knowledge on Household Water Use,
W89-00877 6D

Developing and Assessing a Model of Residential Water Conservation,
W89-00881 3D

Effect of Upgrading a Tubewell Water Supply in Rural Areas of Bangladesh,
W89-00920 5F

DRAINAGE
Effect of Assumed Unit Gradient During Drainage on the Determination of Unsaturated Hydraulic Conductivity and Infiltration Parameters,
W89-00407 2G

DRAINAGE CANALS
Mobile Flume for Circular Channel,
W89-00757 7B

DRAINAGE DITCHES
Runoff Generation in a Plough-drained Peat Bog in Southern Scotland,
W89-00345 4C

DRAINAGE EFFECTS
Runoff Generation in a Plough-drained Peat Bog in Southern Scotland,
W89-00345 4C

DRAINAGE PATTERNS
Fractal Nature of River Networks,
W89-00975 2E

DRAINAGE SYSTEMS
Ochre Deposits and Associated Bacteria in Some Field Drains in Scotland,
W89-00412 2G

DRAWDOWN
Seed Germination Traits of Annuals and Emergents Recruited during Drawdowns in the Delta Marsh, Manitoba, Canada,
W89-00126 2H

Drawdown Interval Analysis: A Method of Determining the Parameters of Shallow Conduit Flow Carbonate Aquifers from Pumping Tests,
W89-00986 2F

DRAWDOWN INTERVAL ANALYSIS
Drawdown Interval Analysis: A Method of Determining the Parameters of Shallow Conduit Flow Carbonate Aquifers from Pumping Tests,
W89-00986 2F

DREDGING
Optimization of the Mud Intakes of Dredges with Submersible Pumps,
W89-00044 8C

Excavation of Heavy Soils by Dredges,
W89-00068 8H

Dredging Activities in the Dutch Wadden Sea: Effects on Macrobenthic Infauna,
W89-00151 2L

Lake Dredging Boosts Recreational and Esthetic Environments,
W89-00468 5G

DRILLING
Characteristics of the Organization and Performance of Works in the Dam Foundation of the Al-Hadithah Hydro Development (Iraq),
W89-01182 8F

DRILLING FLUIDS
Acute Toxicities of Eleven Metals to Early Life-History Stages of the Yellow Crab Cancer anthonyi,
W89-00386 5C

Degradation of Low-Toxicity Oil-Based Drilling Mud in Benthic Sediments around the Beatrice Oilfield,
W89-00792 5B

DRINKING WATER
Chemical Methods of P-Elimination in the Tributaries of Reservoirs and Lakes,
W89-00020 5G

Trace Element Content in Drinking Water of Nasopharyngeal Carcinoma Patients,
W89-00048 5C

Guinea Worm Disease in Northern Uganda: A Major Public Health Problem Controllable Through an Effective Water Programme,
W89-00278 5F

Incidence of Coliphage in Potable Water Supplies,
W89-00338 5F

Controlling Swampy Odors in Drinking Water,
W89-00425 5F

Evaluating the Modifications to the MF Total Coliform Method for Drinking Water with High Noncoliform Backgrounds,
W89-00427 5A

Rapid Specific Environmental Coliform Monitoring,
W89-00445 5A

Chloropicrin in Potable Water: Conditions of Formation and Production during Treatment

DRINKING WATER

Processes (La Chloropicrine dans les Eaux Potables: Conditions de Formation et Evolution le long des Filieres de Traitement),
W89-00635 5F

Determination of Fluoride Ion in Well Waters of Eastwood School District, Wood County, Ohio,
W89-00684 5A

Comparison of Bacterial Indicators and Sampling Programs for Drinking Water Systems,
W89-00733 5A

Rapid Detection of Total and Fecal Coliforms in Water by Enzymatic Hydrolysis of 4-Methylumbelliferone-beta-D-Galactoside,
W89-00734 5A

Modern Management Standards of Water Network Register (Criteres Modernes de Gestion du Cadastre des Reseaux d'Eau),
W89-00919 5F

Effect of Upgrading a Tubewell Water Supply in Rural Areas of Bangladesh,
W89-00920 5F

Epidemiological Study of the Legionella pneumophila Presence in Potable Water in Alicante,
W89-00925 5A

Definition of a Model for Monitoring the Chemical and Chemical-Physical Characteristics of Deep Drinking Waters,
W89-00927 7C

Activity Assessment in Drinking Water Bacteriology - A Comparison of Methods and Possibilities,
W89-00928 5A

Modeling Contaminant Propagation in Drinking Water Distribution Systems,
W89-00929 5F

Radionuclides in Drinking Water,
W89-01104 5B

DROUGHTS

Texas Drought History Reconstructed and Analyzed from 1698 to 1980,
W89-00273 2B

DUAL-LABEL METHOD

Estimating Bacterial Production in Marine Waters from the Simultaneous Incorporation of Thymidine and Leucine,
W89-00729 7B

DUCK CREEK RESERVOIR

Macroinvertebrate Populations in a Thermally Impacted Reservoir,
W89-00397 5C

DUCKWEED

Speciation Studies of Copper and Magnesium in Duckweed Extract Using Interfaced HPLC and Thermospray Neubulizer Flame AA,
W89-00886 5D

Use of Duckweed for Wastewater Treatment,
W89-01128 5D

DUCKWEEDS

Chromium Removal from Water by Three Species of Duckweeds,
W89-00109 5D

DUSTS

Influence of Dusts from Chosen Industrial Plants on Particular Links of Forest Ecosystem of the Niepolomice Forest,
W89-00081 5C

DYE INDUSTRY WASTES

Treatment of Dye-Containing Effluents with Different Bentonites,
W89-00615 5D

DYES

Multi-Component Sorption Isotherms of Basic Dyes onto Peat,
W89-00083 5D

Selected Dyes for Residence Time Distribution Evaluation in Bioreactors,
W89-00404 5D

Removal of Chrome Dye from Carpet Effluents Using Coal: I,
W89-00630 5D

Adsorption of Indigo Carmine by Activated Carbon,
W89-00633 5D

Reactivity of the Carbonate Radical with Aniline Derivatives,
W89-01088 5B

DYNAMIC PROGRAMMING

Gradient Dynamic Programming for Stochastic Optimal Control of Multidimensional Water Resources Systems,
W89-00979 6A

DYSTROPHIC LAKES

Changes in Phytoplankton Over a Ten-Year Period in a Lake Undergoing De-Eutrophication due to Surrounding Peat Bogs,
W89-00196 2H

E. J. BECK LAKE

Pioneer Colonization and Interaction of Photosynthetic and Heterotrophic Microorganisms on an Artificial Substrate of Polyurethane Foam in E. J. Beck Lake, Illinois,
W89-00398 2H

EARTH DAMS

Assignment of the Characteristics of Clay-Rubble Soils in Watertight Components of Earth Dams,
W89-00036 8D

Use of Horizontal Drainage for Draining Dam Slopes,
W89-00040 8C

Selection of a Method for Computer-aided Design of Earth Dams,
W89-00056 8D

Deformation of Dams with a Facing and Their Seismic Stability,
W89-00070 8D

Effect of Seepage on Earth Dams,
W89-00550 8D

Evaluation of the Reliability of Wave-Protection Slab Revetments of Embankment Slopes,
W89-01176 8D

EARTHQUAKES

Earthquake Response of Submerged Circular Arch,
W89-00306 8A

Hydrodynamic-Stiffness Matrix Based on Boundary Elements for Time-Domain Dam-Reservoir-Soil Analysis,
W89-00447 8B

Transient Pressures in Hydrotechnical Tunnels During Earthquakes,
W89-00448 8E

EBB TIDE

Fluvial Sedimentation in the Ebb-Dominated Orange Estuary,
W89-00456 2J

ECOHYDROLOGY

Ecohydrological Approach to Floral and Vegetational Patterns in Arctic Landscape Ecology,
W89-00435 2H

ECOLOGICAL DISTRIBUTION

Growth Strategies and Distribution of Isoetids in Scottish Freshwater Lochs,
W89-00129 5C

Habitat Requirements and Bioindicator Value of the Main Communities of Aquatic Vegetation in North-East Poland,
W89-00235 2H

ECOLOGICAL EFFECTS

Experiences With the Assessment of the Residual Water Flow in Regulated Water Courses in the Salzburg Region (Erfahrungen bei der Beurteilung der Restwasserfuhrung von Ausleitungsstrecken im Land Salzburg),
W89-00164 4A

Effects of Disturbance and Severe Seasonal Fluctuations in Environmental Conditions on North Temperate Shallow-water Fish Assemblages,
W89-00282 2L

Risk Analysis for Fish Diversion Experiments: Pumped Intake Systems,
W89-00318 8I

Reduction of a Dolly Varden Population and Macrobenthos after Removal of Logging Debris,
W89-00322 4C

Effects of Stream Cleaning on Juvenile Coho Salmon and Dolly Varden in Southeast Alaska,
W89-00374 2H

Homing of Adult Chinook Salmon after Brief Exposure to Whole and Dispersed Crude Oil,
W89-00375 5C

Tidal Power Ruffles Feathers,
W89-00850 8A

Results of Ecological Monitoring of Three Beaches Polluted by the 'Amoco Cadiz' Oil Spill: Development of Meiofauna from 1978 to 1984,
W89-01031 5C

ECOLOGY

Spatial and Temporal Distribution Patterns of Three Trophic Levels in a Saline Lake,
W89-00219 2H

Phagotrophic Phototrophs: The Ecological Significance of Mixotrophy,
W89-00384 2H

Long-Term Ecological Research on Illinois Rivers,
W89-00401 2H

Ecohydrological Approach to Floral and Vegetational Patterns in Arctic Landscape Ecology,
W89-00435 2H

Effects of Disturbances Along Hydroelectrical Transmission Corridors Through Peatlands in Northern Manitoba, Canada.
W89-00436 4C

Ecological Role of the Red-Knobbed Coot, Fulica cristata Gmelin, at the Bot River Estuary, South Africa: A Preliminary Investigation,
W89-00662 2L

Synopsis of the Impact of Artificially Opening the Mouth of the Bot River Estuary: Implications for Management,
W89-00666 2L

Ecology of Freshwater Gastropods in the Central Canadian Region,
W89-01183 2H

ECONOMIC ASPECTS
New Life for Small Hydroelectric Stations in Kirgizia,
W89-00042 8C

Manufacture of Polyethylene Seals for High-head Gates of Hydraulic Structures,
W89-00043 8G

Land Application of Domestic Wastewater, Wood Production, and Sludge Composting: An Economic and Energy Production Analysis,
W89-00465 5E

Geography of the Estuary and Firth of Clyde,
W89-00798 2L

Conservation of Natural Resources,
W89-00827 6E

O and M Spending Levels in Third World Irrigation Systems: Exploring Economic Alternatives,
W89-00874 3F

Management of a Tributary Aquifer,
W89-00978 4B

Ex Post Analysis of Flood Control: Benefit-Cost Analysis and the Value of Information,
W89-00983 6C

Copper, Nickel, and Chrome Recovery in a Jobshop to Eliminate Waste Treatment and Sludge Disposal,
W89-00993 5D

Look to the Future: Environmental Education,
W89-01121 5G

Changing Meaning of Water Conservation in the West,
W89-01269 6E

ECONOMIC DEVELOPMENT
Changes in the Ecosystem of the Azov Sea in Relation to Economic Development in the Basin,
W89-01192 6G

ECONOMIC EFFICIENCY
Cost Efficiency of Transferable Discharge Permit Markets for Control of Multiple Pollutants,
W89-00697 5G

ECOSYSTEMS
Development of Microorganisms on the Background of Organic Matter in Forest Ecosystem Waters,
W89-00080 2H

Model Ecosystems as a Tool in Freshwater and Marine Research,
W89-00180 5B

Habitat Requirements and Bioindicator Value of the Main Communities of Aquatic Vegetation in North-East Poland,
W89-00235 2H

Limnocorral Experiments in a Eutrophic Lake - Effects of Fish on the Planktonic and Chemical Conditions,
W89-00253 2H

International Control of Cross-Media Pollution: An Ecosystem Approach,
W89-00520 5G

Long-term Study of Ecosystem Contamination with 2,3,7,8-Tetrachlorodibenzo-p-dioxin,
W89-00603 5B

Primary Productivity of the Bot River Estuary, South Africa,
W89-00656 2L

Variations in the Use of the Bot River Estuary by Water-Birds,
W89-00661 2L

Ecological Role of the Red-Knobbed Coot, Fulica cristata Gmelin, at the Bot River Estuary, South Africa: A Preliminary Investigation,
W89-00662 2L

Eutrophication and Benthic Fauna of Three Mountain Lakes (Eutrophisation et Faune Benthique de Trois Lacs de Montagne),
W89-00695 5C

Microbial-Meiofaunal Interrelationships in Some Tropical Intertidal Sediments,
W89-00766 2L

Changes in the Ecosystem of the Azov Sea in Relation to Economic Development in the Basin,
W89-01192 6G

EDDY DIFFUSION
Dynamical Structure of Vertically Two-Dimensional Estuary in Steady State,
W89-00680 2L

EDUCATION
Hydrological Perspective,
W89-01011 2A

AWWA Small Systems Program,
W89-01114 5F

Look to the Future: Environmental Education,
W89-01121 5G

EELGRASS
Model of Zostera marina L. Photosynthesis and Growth: Simulated Effects of Selected Physical-Chemical Variables and Biological Interactions,
W89-00130 2L

EELPOUT
Monitoring of Mercury Pollution in Dutch Coastal Waters by Means of the Teleostean Fish Zoarces Viviparus,
W89-00150 5C

EFFLUENTS
Testing the Secondary Treatment of Effluents from the 'Police' Chemical Plant in Carp Ponds,
W89-00255 5D

Application of Headspace Gas Chromatography to the Monitoring of Organic Substances in Industrial Effluent,
W89-00572 5A

Use of the Clyde Estuary and Firth for the Disposal of Effluents,
W89-00824 5E

Quality Control Approach to NPDES Compliance Determination,
W89-01136 5D

Monitoring of Liquid Effluents as Preventative Protection of Natural Bodies of Water (Abwasseruberwachung als vorbeugender Gewasserschutz),
W89-01184 5G

Review of Rock Filters for the Upgrade of Lagoon Effluents,
W89-01235 5D

EGGS
Organochlorines and Eggshell Thinning in Northern Gannets (Sula bassanus) from Eastern Canada, 1968-1984,
W89-01054 5C

Variations in Polychlorinated Biphenyl Congener Composition in Eggs of Mediterranean Water Birds in Relation to their Position in the Food Chain,
W89-01056 5B

Effects of Cadmium on Early Developmental Stages of the Sheepshead Minnow (Cyprinodon Variegatus),
W89-01091 5C

EGGSHELL THINNING
Organochlorines and Eggshell Thinning in Northern Gannets (Sula bassanus) from Eastern Canada, 1968-1984,
W89-01054 5C

EGYPT
Incidence of Coliphage in Potable Water Supplies,
W89-00338 5F

Environmental Conditions in Abu Kir Bay, East of Alexandria: I. Physico-chemical Characteristics and Water Circulation,
W89-00565 5B

Environmental Conditions in Abu Kir Bay, East of Alexandria: II. Plankton Distribution, Downstream from Land-Based Effluents,
W89-00578 5C

EL NINO
El Nino-Southern Oscillation and Rainfall Variability,
W89-00276 2B

El Nino and Its Effect on Precipitation in Arizona and Western New Mexico,
W89-00474 2B

ELASTICITY THEORY
Calculation of an Arch Dam on the Basis of Solving the Three-dimensional Problem of the Theory of Elasticity and Theory of Shells,
W89-00057 8A

ELBE RIVER
Soft Bottom Fauna Near the River Elbe Estuary under the Influence of Sewage Sludge. I. Seasonal Variation of Species Number, Abundance and Biomass in Relation to Sediment Structure (Die Weichbodenfauna vor der Elbemuendung unter dem Einfluss der Klaerschlammverklappung. I. Die Saisonale Veraenderung von Arten- und Individuenzahl sowie Biomasse unter Beruecksichtigung der Sedimentstrucktur),
W89-00316 5C

Chlorinated Hydrocarbons in Sediments of the Elbe River and the Elbe Estuary,
W89-00614 5B

ELECTRIC POWER DEMAND
Small Hydroelectric Stations and Prospects of Their Development,
W89-00059 8C

ELECTRIC POWER DEVELOPMENT
Future Prospects for Hydro Electricity and Windpower,
W89-00793 6C

ELECTRIC POWER LINES
Effects of Disturbances Along Hydroelectrical Transmission Corridors Through Peatlands in Northern Manitoba, Canada.
W89-00436 4C

ELECTRICAL CHARGE MEASUREMENT
Charge Induced on a Conducting Cylinder by a Point Charge and Its Application to the Measurement of Charge on Precipitation,
W89-00762 7B

ELECTRICAL EQUIPMENT
Improvement of the Electrical Equipment and Control Systems to the Lock Mechanisms of the Moscow Canal,
W89-00052 8C

Power Facilities of the Moscow Canal,
W89-00053 8C

ELECTRICAL EQUIPMENT

Hydropower Equipment of the Moscow Canal,
W89-00054 8C

ELECTRICAL PROPERTIES

Charge Induced on a Conducting Cylinder by a Point Charge and Its Application to the Measurement of Charge on Precipitation,
W89-00762 7B

ELECTRICAL STUDIES

Charge Induced on a Conducting Cylinder by a Point Charge and Its Application to the Measurement of Charge on Precipitation,
W89-00762 7B

ELECTRICAL WELL LOGGING

General Correction for Spontaneous Potential Well Logs in Fresh Water,
W89-01195 7B

ELECTROCHEMISTRY

Can the Redox Conditions in Natural Waters be Predicted by a Single Parameter,
W89-00688 2K

Interpretation and Measurement of Redox Intensity in Natural Waters: A Comment to T. Frevert's Paper, 'Can the Redox Conditions in Natural Waters be Predicted by a Single Parameter',
W89-00689 2K

ELECTRON MICROSCOPY

Scanning Electron Microscopy of Bacteria and Diatoms Attached to a Submerged Macrophyte in an Increasingly Polluted Stream,
W89-00132 5C

Transmission Electron Microscopic Study of Solidified/Stabilized Organics,
W89-01000 5E

ELECTRONICS

Water/Wastewater Facilities Get Better with Electronics,
W89-00392 5D

ELODEA

Lake Enrichment by Submersed Macrophytes: A Norwegian Whole-Lake Experience with Elodea canadensis,
W89-00131 2H

ELY RIVER

Algal Studies of the River Ely, South Wales, U.K.: I. Phytoplankton,
W89-00678 2H

Algal Studies of the River Ely, South Wales, U.K.: II. Epilithic Algae,
W89-00679 2H

EMBANKMENTS

Filterless Revetment of the Slopes of Dikes at Pumped-storage Station Reservoirs,
W89-00058 8A

Effects on the Benthic Fauna of Embanking an Intertidal Flat Area (The Markiezaat, Eastern Scheldt Estuary, The Netherlands),
W89-00676 6G

Evaluation of the Reliability of Wave-Protection Slab Revetments of Embankment Slopes,
W89-01176 8D

EMBRYONIC GROWTH STAGE

Toxicity of Sea-Surface Microlayer: Effects On Herring and Turbot Embryos,
W89-00855 5C

EMBRYONIC GROWTH STAGES

Toxicity of Sea-Surface Microlayer: Effects of Hexane Extract on Baltic Herring (Clupea harengus) and Atlantic Cod (Gadus morhua) Embryos,
W89-00856 5C

EMBRYOS

Effect of Low pH on Survival of Brook Trout Embryos and Yolk-Sac Larvae in West Virginia Streams,
W89-00293 5C

Prediction of Rainbow Trout Embryo Survival in Relation to Groundwater Seepage and Particle Size of Spawning Substrates,
W89-00326 2H

ENFORCEMENT

Role of the States in Solving the Small System Dilemma,
W89-01111 6E

Restoration of Wetlands under Section 404 of the Clean Water Act: An Analytical Synthesis of Statutory and Case Law Principles,
W89-01189 6E

ENGINEERING GEOLOGY

Gas Shows during Construction of Hydraulic Tunnels,
W89-00071 8E

Calculation of Pressure Tunnel Linings with Consideration of Consolidation Grouting of the Rocks,
W89-00547 8C

Determination of the Mechanical Characteristics of Rocks by the Method of Volume Confinement of Deformations,
W89-00548 8E

Experience in Determining the Numerical Characteristics of Landslide Movements,
W89-00551 8A

ENGINEERING PERSONNEL

Look to the Future: Environmental Education,
W89-01121 5G

ENGLAND

Nitrite and Ammonia in the Tamar Estuary,
W89-00154 5B

Comparison of Nutrients in the Interstitial Water of Reducing (Tamar Estuary) and Oxic (Carmarthen Bay) Coastal Sediments,
W89-00156 2L

Role of Sewage Effluent in the Accumulation of Macroalgal Mats on Intertidal Mudflats in Two Basins in Southern England,
W89-00159 5C

Field Study of the Cloud Chemistry and Cloud Microphysics at Great Dun Fell,
W89-00308 5B

Summer of 1987 in North-East England,
W89-00463 2B

London Water Ring Main,
W89-00840 5F

Tidal Power Ruffles Feathers,
W89-00850 8A

Recent Transport of Metals in the River Severn as Recorded by the Sediments of Chelmarsh Reservoir, Shropshire, U.K.,
W89-00885 5B

Stream Nitrate Levels in a Small Catchment in South West England Over a Period of 15 Years (1970 - 1985),
W89-00915 5B

Use of Network Analysis Techniques in the Development and Optimization of a large UK Urban Water Distribution System (L'Emploi de Techniques),
W89-00918 5F

Water Quality Management: A Regional Perspective-The Severn-Trent Area,
W89-00951 5G

River Regulation by Seasonal Groundwater Abstraction: The Case of the River Itchen,
W89-00956 4B

Impact of River Regulations on Invertebrate Communities in the U.K.,
W89-00959 4A

Influence of Altitude on Rainfall Composition at Great Dun Fell,
W89-01146 5B

Influence of Altitude on Wet Deposition: Comparison between Field Measurements at Great Dun Fell and the Predictions of a Seeder-Feeder Model,
W89-01147 5B

ENRICHMENT

Lake Enrichment by Submersed Macrophytes: A Norwegian Whole-Lake Experience with Elodea canadensis,
W89-00131 2H

ENTEROVIRUSES

Relationship between Numbers of Enteroviruses and Bacteriophages Infecting Bacteroides fragilis in Different Environmental Samples,
W89-00645 5A

ENTRAINMENT

Modified Fickian Model for Solute Uptake by Runoff,
W89-00486 5B

ENTROPY

Maximum Entropy Spectral Analysis of Hydrologic Data,
W89-01248 2A

ENVIRONMENTAL CHLORIDE METHOD

Validity of the Environmental Chloride Method for Recharge Evaluation of Coastal Aquifers, India.
W89-00356 7B

ENVIRONMENTAL CONTROL

Maximally Informative Environmental Control Policies for Natural Resource Systems with Probabilistic Constraints,
W89-00458 6A

California Tahoe Conservancy: Applying the Principles,
W89-01068 6E

Prospects for Transfer of the California Coastal Conservancy Model for Habitat Restoration to Other Coastal States,
W89-01070 6E

ENVIRONMENTAL EFFECTS

Effect of a Heated Wastewater Discharge upon River Protozoan Species Pool Variability through Time and Space,
W89-00077 5C

Influence of Dusts from Chosen Industrial Plants on Particular Links of Forest Ecosystem of the Niepolomice Forest,
W89-00081 5C

Dredging Activities in the Dutch Wadden Sea: Effects on Macrobenthic Infauna,
W89-00151 2L

Environmental Effects of Paper Industry Wastewaters: An Overview,
W89-00362 5C

Effects of Pulp Mill Effluent on a Baltic Coastal Fish Community,
W89-00366 5C

Effects of Disturbances Along Hydroelectrical Transmission Corridors Through Peatlands in Northern Manitoba, Canada.
W89-00436 4C

Frequent and Important Consequences from Increased Amounts of Liquid Manure (Haeufige und Wichtige Folgen Vermehrten Guelleanfalls),
W89-00500 5B

Toxic and Environmental Torts within Admiralty,
W89-00518 6E

Nonparametric Approaches to Environmental Impact Assessment,
W89-00861 7C

Hydropower Development on Rivers in Scotland,
W89-00952 8C

Regulation of the River Dee,
W89-00953 4A

Regulation of the River Thames: A Case Study on the Teddington Flow Proposal,
W89-00955 4A

River Regulation and Nature Conservation,
W89-00961 4A

Outstanding Problems in River Regulation,
W89-00963 4A

Planning and Construction of the Pahalgam Scheme,
W89-01004 8A

Effects of a Simulated Acid Precipitation on Leaf Litter Quality and the Growth of a Detritivore in a Buffered Lotic System,
W89-01058 5C

Effects of Cadmium on Early Developmental Stages of the Sheepshead Minnow (Cyprinodon Variegatus),
W89-01091 5C

Effects of Acute Exposure to Acidified Water on the Behavorial Response of Fathead Minnows, Pimephales Promelas, to Alarm Substance (Schreckstoff),
W89-01092 5C

Pesticides: A Continuing Dilemma,
W89-01122 5B

ENVIRONMENTAL ENGINEERING

Look to the Future: Environmental Education,
W89-01121 5G

ENVIRONMENTAL GRADIENT

Spatial Patterns of N Fixation (Acetylene Reduction) along Environmental Gradients in a Warm-Temperate Estuary,
W89-00475 2L

ENVIRONMENTAL IMPACT

Nonparametric Approaches to Environmental Impact Assessment,
W89-00861 7C

Assessing the Influence of Environmental Parameters on the Hydrological Cycle,
W89-00916 2A

Streamflow Regulation and Fish Community Structure,
W89-01053 4A

ENVIRONMENTAL POLICY

Eutrophication of Lakes and Reservoirs: A Framework for Making Management Decisions,
W89-00439 5C

International Control of Cross-Media Pollution: An Ecosystem Approach,
W89-00520 5G

California Tahoe Conservancy: Applying the Principles,
W89-01068 6E

Prospects for Transfer of the California Coastal Conservancy Model for Habitat Restoration to Other Coastal States,
W89-01070 6E

Restoration of Wetlands under Section 404 of the Clean Water Act: An Analytical Synthesis of Statutory and Case Law Principles,
W89-01189 6E

Cities Supported by Sticks in the Mud: A Variation on the Settlement of Land and Structures Caused by Ground Water Removal,
W89-01190 6E

New Directions in Nebraska Water Policy,
W89-01266 6E

ENVIRONMENTAL PROTECTION

Feedback Dependence Between the Eutrophication Process and Changes in the Fish Community: The Theory of Ichthyoeutrophication (Sprzezenie zwrothe miedzy procesum eutrofizacji a zmianami zespolu ryb. Tesri ichtioeutrofizacji),
W89-00031 5C

Innovative Septic System Management,
W89-00508 5D

ENVIRONMENTAL QUALITY

Eutrophication of Lakes and Reservoirs: A Framework for Making Management Decisions,
W89-00439 5C

Is Water a Relevant Sampling Medium for Toxic Chemicals: An Alternative Environmental Sensing Strategy,
W89-01162 5A

ENVIRONMENTAL TRACERS

Transport Modelling of Biological Tracers from Septic Systems,
W89-01226 5B

ENZYMES

Nitrate Reductase Activity in Phytoplankton from the Oslo-fjord, Norway,
W89-00226 2H

Immobilization of Leachable Toxic Soil Pollutants by Using Oxidative Enzymes,
W89-00341 5G

Rapid Detection of Total and Fecal Coliforms in Water by Enzymatic Hydrolysis of 4-Methylumbelliferone-beta-D-Galactoside,
W89-00734 5A

Interspecific, Seasonal and Diel Variations in Zooplankton Trypsin and Amylase Activities in Kosterfjorden, Western Sweden,
W89-01040 2L

EPIDEMIOLOGY

Guinea Worm Disease in Northern Uganda: A Major Public Health Problem Controllable Through an Effective Water Programme,
W89-00278 5F

Epidemiological Study of the Legionella pneumophila Presence in Potable Water in Alicante,
W89-00925 5A

EPILIMNION

Sampling Strategies and Associated Errors in Estimating Epilimnetic Chlorophyll in Eutrophic Lakes,
W89-01242 2H

EPIPHYTES

Loss of Seagrass in Cockburn Sound, Western Australia: II. Possible Causes of Seagrass Decline,
W89-00116 5C

Scanning Electron Microscopy of Bacteria and Diatoms Attached to a Submerged Macrophyte in an Increasingly Polluted Stream,
W89-00132 5C

Studies on Epilithic and Epiphytic Diatoms in a Chalkstream: Comparative Estimates of Chlorophyll a and Its Derivatives,
W89-01186 2H

EROSION

Natural Degradation Ability of Lakes and the Role of Drainage Area in the Process (Ocena naturalnej podatnosci jezior na degradacje i rola zlewni u tym procesie),
W89-00032 2H

Effect of Runoff Variability on Deformation of Erodible Channels near Structures,
W89-00072 2J

Great Lakes Shore Erosion,
W89-00133 4D

Effect of Sodium Nitrate and Gypsum on Infiltration and Erosion of a Highly Weathered Soil,
W89-00409 2G

Dynamic Changes and Processes in the Mississippi River Delta,
W89-00469 2J

Coastal Topography of the Moray Firth,
W89-00775 2L

Erosion and Sediment Yield Research: Some Recent Perspectives,
W89-01015 2J

Alluvial Channel Hydraulics,
W89-01017 2J

EROSION CONTROL

Multicriterion Stormwater Management Methods,
W89-00302 4A

ESCHERICHIA COLI

National Field Evaluation of a Defined Substrate Method for the Simultaneous Enumeration of Total Coliforms and Escherichia coli from Drinking Water: Comparison with the Standard Multiple Tube Fermentation Method,
W89-00337 5A

Metabolic Processes Involved in Repair of Escherichia coli Cells Damaged by Exposure to Acid Mine Water,
W89-00727 5C

ESKER AQUIFERS

Esker Aquifers,
W89-00264 4B

ESTIMATING

Geostatistics Applied to Groundwater Pollution: III. Global Estimates,
W89-00493 5B

Statistical Methods and Sampling Design for Estimating Step Trends in Surface-Water Quality,
W89-00862 7A

ESTUARIES

Phytoplankton Composition of Stagnant and Tidal Ecosystems in Relation to Salinity, Nutrients, Light and Turbulence,
W89-00001 2L

Distribution, Dynamics and Productivity of a Colonizing (Polydora quadrilobata) and an Established (P. ligni) Polydorid Polychaete in Lake Grevelingen: An Enclosed Estuary in the SW Netherlands,
W89-00002 2H

Suspended Matter and Bottom Deposits in the Mahury Estuarine System (French Guiana): Environmental Consequences,
W89-00003 2J

Effects of River Discharge and Vertical Circulation on Aquatic Primary Production in a Turbid Louisiana (USA) Estuary,
W89-00005 2L

Seasonal Abundance and Distribution of Drift Algae and Seagrasses in the Mid-Indian River Lagoon, Florida,
W89-00104 2L

Nitrogen Pools and Soil Characteristics of a Temperate Estuarine Wetland in Eastern Australia,
W89-00110 5B

Effect of Sediment Depth and Sediment Type on the Survival of Vallisneria americana Michx Grown from Tubers,
W89-00114 2H

Effects of Sediment Properties on Benthic Primary Production in the Columbia River Estuary,
W89-00115 2L

Role of Marsh Plants in the Transport of Nutrients as Shown by a Quantitative Model for the Freshwater Section of the Elbe Estuary,
W89-00120 2L

Residual Fluxes of Water in an Estuarine Lagoon,
W89-00142 2L

Nutrient Dynamics in Cumberland Basin - Chignecto Bay, A Turbid Macrotidal Estuary in the Bay of Fundy, Canada,
W89-00152 2L

Nitrite and Ammonia in the Tamar Estuary,
W89-00154 5B

Nitrogen Budget of the Scheldt Hydrographical Basin,
W89-00155 5B

Comparison of Nutrients in the Interstitial Water of Reducing (Tamar Estuary) and Oxic (Carmarthen Bay) Coastal Sediments,
W89-00156 2L

Chemical Behavior of Metal Elements in the Sediments in the Hanjiang River Estuary and Shantou Port, (in Chinese),
W89-00202 2L

Distribution of Agglutinated Foraminifera in Bottom Sediments of the Zhujiang River Estuary, (in Chinese),
W89-00203 2L

Nutrient Levels and the Development of Diatom and Blue-Green Blooms in a Shallow Australian Estuary,
W89-00211 2H

Tidal Transport of Planktonic Copepods across the Sill of a British Columbia Fjord,
W89-00221 2L

Rotifers of Warri River, Nigeria,
W89-00222 2H

Tintinnids and Other Microzooplankton - Seasonal Distributions and Relationships to Resources and Hydrography in a Maine Estuary,
W89-00223 2L

Short-Term Variations in the Zooplankton Community Related to Water Exchange Processes in the Gullmar Fjord, Sweden,
W89-00228 2H

Effects of Increasing Salinity on a Cyanobacteria Bloom in the Potomac River Estuary,
W89-00231 2H

Meteorologically Induced Flushing in Three U.S. East Coast Estuaries,
W89-00281 2L

PCB-resistant Diatoms in the Hudson River Estuary,
W89-00284 5C

Dissolved Mercury Behaviour in the Saint Lawrence Estuary,
W89-00285 5B

Water Column Productivity Attributable to Displaced Benthic Diatoms in Well-Mixed Shallow Estuaries,
W89-00297 2L

Soft Bottom Fauna Near the River Elbe Estuary under the Influence of Sewage Sludge. I. Seasonal Variation of Species Number, Abundance and Biomass in Relation to Sediment Structure (Die Weichbodenfauna vor der Elbemuendung unter dem Einfluss der Klaerschlammverklappung. I. Die Saisonale Veraenderung von Arten- und Individuenzahl sowie Biomasse unter Beruecksichtigung der Sedimentstrucktur),
W89-00316 5C

River-Forced Estuarine Plumes,
W89-00414 2L

Shear Instability in a Highly Stratified Estuary,
W89-00415 2L

Concentrations of Trace Metals in the Qiantagnjiang River and its Estuary in Southern China,
W89-00443 5B

Flux of Organic Carbon in a Tidal Salt Marsh, Kowie River Estuary, Port Alfred, South Africa,
W89-00453 2L

Factors Influencing Aboveground Production of Scirpus Marshes in the St. Lawrence Estuary, Quebec, Canada,
W89-00529 2L

Analysis of the Effects of Suspended Sediment of Huanghe River on Harbor Construction by Using NOAA Images, (in Chinese),
W89-00536 2J

Studies on Marine Humic Substances: III. The Distribution of Humic Substances in Seawater and Sediments in the Estuary of Changjiang River and East China Sea, (in Chinese),
W89-00541 2L

Numerical Simulation on Typhoon Surge and Surge Estimation of Huanghe River Estuary Region in Bohai Sea, (in Chinese),
W89-00543 2L

Chromium Speciation in the Huanghe River and Its Estuarine Region, (in Chinese),
W89-00544 5B

Studies on Marine Humic Substances: IV. The Distribution of Humic Substances in the Seawater and Sediments of Huanghe River Estuary, (in Chinese),
W89-00545 2L

Environmental Conditions in Abu Kir Bay, East of Alexandria: I. Physico-chemical Characteristics and Water Circulation,
W89-00565 5B

Bacteriological Contamination of the Eastern Part of the Gulf of Trieste (North Adriatic) Due to Sewage Discharge,
W89-00577 5B

Trophic State Gradients and Zooplankton and Zoobenthos Distribution in a Po River Delta Lagoon,
W89-00580 2L

Geomorphology, Offshore Bathymetry and Quaternary Lithostratigraphy around the Bot River Estuary,
W89-00649 2L

Barrier/Estuarine Processes. Bot River Estuary: An Interpretation of Aerial Photographs,
W89-00650 2L

Bathymetry, Environmental Parameters and Sediments of the Bot River Estuary, S.W. Cape Province.
W89-00651 2L

Numerical Model for the Wind-Driven Circulation in the Bot River Estuary,
W89-00652 2L

Historical Records of the Bot River Estuarine System,
W89-00653 2L

Hydrology of the Bot River Estuary,
W89-00654 2L

Physical and Chemical Characteristics of the Waters of the Bot River Estuary, South Africa,
W89-00655 2L

Primary Productivity of the Bot River Estuary, South Africa,
W89-00656 2L

Effect of Salinity and Temperature Variations on the Bacterial Population in the Bot River Estuary,
W89-00657 2L

Annual Cycle of Free-Floating Bacteria in the Bot River Estuary,
W89-00658 2L

Zooplankton and Some Environmental Conditions in the Bot River Estuary,
W89-00659 2L

Benthic Macrofauna of the Bot River Estuary, South Africa, with a Note on Its Meiofauna,
W89-00660 2L

Variations in the Use of the Bot River Estuary by Water-Birds,
W89-00661 2L

Ecological Role of the Red-Knobbed Coot, Fulica cristata Gmelin, at the Bot River Estuary, South Africa: A Preliminary Investigation,
W89-00662 2L

Comparison of the Physiological Condition of the Southern Mullet Liza richardsoni (Smith), in a Closed Estuary and the Sea,
W89-00663 2L

Mass Mortality of Fish Associated with Low Salinity Conditions in the Bot River Estuary,
W89-00664 2L

Changes in the Fish Fauna of the Bot River Estuary in Relation to Opening and Closure of the Estuary Mouth,
W89-00665 2L

Synopsis of the Impact of Artificially Opening the Mouth of the Bot River Estuary: Implications for Management,
W89-00666 2L

Experimental Determination of Salt Intrusion Mechanisms in the Volkerak Estuary,
W89-00667 2L

Comparison of Methods for the Determination of Chlorophyll in Estuarine Sediments,
W89-00668 2L

Tidal Asymmetry and Estuarine Morphology,
W89-00670 2L

Flocculation and De-Flocculation of Suspended Matter in Estuaries,
W89-00671 2L

Partitioning of Organochlorines Between Water, Particulate Matter and Some Organisms in Estuarine and Marine Systems of the Netherlands,
W89-00672 5B

Dynamics of Dissolved Silicium and Nitrogen-Nutrients at Low Temperature in the EMS-Dollard Estuary,
W89-00673 2L

Adventures in Holistic Ecosystem Modelling: The Cumberland Basin Ecosystem Model,
W89-00675 2L

Effects on the Benthic Fauna of Embanking an Intertidal Flat Area (The Markiezaat, Eastern Scheldt Estuary, The Netherlands),
W89-00676 6G

Dynamical Structure of Vertically Two-Dimensional Estuary in Steady State,
W89-00680 2L

Geological and Geomorphological Setting of the Estuary and Firth of Clyde,
W89-00799 2L

Fresh Water Inflows to the Firth of Clyde,
W89-00801 2L

Water Movement and the Simulation of Storm Surges in the Firth of Clyde,
W89-00803 2L

Dynamics of Saltwater Intrusion in Coastal Channels,
W89-00833 2L

Satellite Observations of Tidal Upwelling and Mixing in the St. Lawrence Estuary,
W89-00834 2L

Pollution Beneath the Golden Gate,
W89-00852 5C

Population Genetics of Mytilus edulis (L.) from Oslofjorden, Norway in Oil-Polluted and Non Oil-Polluted Water,
W89-01009 5C

K-Systems Analysis for Determining the Factors Influencing Benthic Microfloral Productivity in a Louisiana Estuary, USA,
W89-01035 2L

Dispersal and Recruitment of Fiddler Crab Larvae in the Delaware River Estuary,
W89-01039 2L

Sediments in the Estuarine Environment of the Tigris/Euphrates Delta, Iraq; Arabian Gulf,
W89-01083 2L

Sedimentary Environments and Facies of the Subtropical Mgeni Estuary, Southeast Africa,
W89-01084 2L

Modeling Blue-Green Algal Blooms in the Lower Neuse River,
W89-01225 5C

ESTUARINE BACTERIA

Mechanisms of DNA Utilization by Estuarine Microbial Populations,
W89-00340 2L

ESTUARINE ENVIRONMENT

River Ems: Processes Affecting the Behaviour of Metals and Organochlorines during Estuarine Mixing,
W89-00149 5B

Dredging Activities in the Dutch Wadden Sea: Effects on Macrobenthic Infauna,
W89-00151 2L

Evaluation of Seasonal Nutrient Dynamics in the Oosterschelde (SW Netherlands),
W89-00153 2L

Spatial Patterns of N Fixation (Acetylene Reduction) along Environmental Gradients in a Warm-Temperate Estuary,
W89-00475 2L

Hydrology of the Bot River Estuary,
W89-00654 2L

Annual Cycle of Free-Floating Bacteria in the Bot River Estuary,
W89-00658 2L

Synopsis of the Impact of Artificially Opening the Mouth of the Bot River Estuary: Implications for Management,
W89-00666 2L

Clearance of Bacteria-Sized Particles by Natural Populations of Nanoplankton in the Chesapeake Bay Outflow Plume,
W89-01032 2L

ESTUARINE ENVIRONMENTS

Bathymetry, Environmental Parameters and Sediments of the Bot River Estuary, S.W. Cape Province.
W89-00651 2L

Primary Productivity of the Bot River Estuary, South Africa,
W89-00656 2L

Zooplankton and Some Environmental Conditions in the Bot River Estuary,
W89-00659 2L

Benthic Macrofauna of the Bot River Estuary, South Africa, with a Note on Its Meiofauna,
W89-00660 2L

Variations in the Use of the Bot River Estuary by Water-Birds,
W89-00661 2L

Ecological Role of the Red-Knobbed Coot, Fulica cristata Gmelin, at the Bot River Estuary, South Africa: A Preliminary Investigation,
W89-00662 2L

Comparison of the Physiological Condition of the Southern Mullet Liza richardsoni (Smith), in a Closed Estuary and the Sea,
W89-00663 2L

Mass Mortality of Fish Associated with Low Salinity Conditions in the Bot River Estuary,
W89-00664 2L

Changes in the Fish Fauna of the Bot River Estuary in Relation to Opening and Closure of the Estuary Mouth,
W89-00665 2L

ESTUARINE SEDIMENTS

Geomorphology, Offshore Bathymetry and Quaternary Lithostratigraphy around the Bot River Estuary,
W89-00649 2L

Bioturbation, Microbial Activity and Sediment Properties in an Estuarine Ecosystem,
W89-00806 2L

ETHYLENEDIAMINETETRAACETIC ACID

Indirect Trace Determination of Ethylenediaminetetraacetic Acid (EDTA) in Water by Potentiometric Stripping Analysis,
W89-00481 5A

EUROPE

Investigation of Transport-Processes along the Elbe River Using Chernobyl Radionuclides as Tracers,
W89-00636 5B

EUTROPHIC LAKES

Freshwater Mollusks as Indicators of Trophic Conditions in Coastal Lakes of Southern Brazil (Moluscos Dulceaquicolas Como Indicadores de Condicoes Troficas em Lagoas Costeiras do Sul do Brasil),
W89-00008 5A

Lake Restoration: Why Oxygenation and Artificial Mixing Cannot Substitute for a Decrease in the External Phosphorus Loading,
W89-00015 5G

Strategies of Lake Sanitation,
W89-00017 5G

Response of Phytoplankton Communities to Changing Lake Environments,
W89-00018 2H

Food Web Manipulation Without Nutrient Control: A Useful Strategy in Lake Restoration,
W89-00019 5G

Chemical Methods of P-Elimination in the Tributaries of Reservoirs and Lakes,
W89-00020 5G

Evaluation of Lake Restoration in Sweden,
W89-00021 5G

Eutrophication Effects of Prey Size and Food Available to Yellow Perch in Lake Erie,
W89-00030 5C

Feedback Dependence Between the Eutrophication Process and Changes in the Fish Community: The Theory of Ichthyoeutrophication (Sprzezenie zwrothe miedzy procesum eutrofizacji a zmianami zespolu ryb. Tesri ichtioeutrofizacji),
W89-00031 5C

Population Dynamics and Production of Chironomidae (Diptera) at 2 m depth in Lake Esrom, Denmark,
W89-00182 2H

Changes in Phytoplankton Over a Ten-Year Period in a Lake Undergoing De-Eutrophication due to Surrounding Peat Bogs,
W89-00196 2H

Characteristics of Distribution and Migration of Phosphorus in Deposits of Dianchi Lake, (in Chinese),
W89-00200 5B

Sedimentation of Phytoplankton Populations Dominated by Microcystis in a Shallow Lake,
W89-00233 2H

Chemical Characteristics of Bottom Sediment Top Layer in Szczytno Male Lake,
W89-00237 2H

Concentrations of Nitrogen and Phosphorus in Waters of Two Hypertrophic Lakes and Their Effect on the Quantity of Phytoplankton Biomass,
W89-00245 2H

Limnocorral Experiments in a Eutrophic Lake - Effects of Fish on the Planktonic and Chemical Conditions,
W89-00253 2H

Differentiation of the Physical and Chemical Properties of Bottom Sediments in Phytocenoses of Myriophylletum verticillati Soo 1927, Potamogetonetum natantis Soo 1927 and Hydrocharitetum morsus-ranae Langendonck 1935 Associations,
W89-00259 2H

Seasonal Change of Iron and Manganese in Lake Fukami-ike: Occurrence of Turbid Manganese Layer,
W89-00770 2H

Dissolved Organic Carbon and Manganese in the Boundary of the Oxic and Anoxic Layers in Lakes Fukami-ike and Suigetsu-ko,
W89-00771 2H

Utilization of Nitrogenous Nutrients by Natural Phytoplankton in Enriched Lake Waters,
W89-00773 2H

Tropical Eutrophic Lake Modeling and Parameter Discrimination,
W89-00872 2H

Sampling Strategies and Associated Errors in Estimating Epilimnetic Chlorophyll in Eutrophic Lakes,
W89-01242 2H

EUTROPHICATION

Availability of Phosphorus Sources for Blooms of Phaeocystis pouchetii (Haptophyceae) in the North Sea: Impact of the River Rhine,
W89-00004 2L

Freshwater Mollusks as Indicators of Trophic Conditions in Coastal Lakes of Southern Brazil (Moluscos Dulceaquicolas Como Indicadores de Condicoes Troficas em Lagoas Costeiras do Sul do Brasil),
W89-00008 5A

Lake Restoration: Why Oxygenation and Artificial Mixing Cannot Substitute for a Decrease in the External Phosphorus Loading,
W89-00015 5G

Eutrophication Effects of Prey Size and Food Available to Yellow Perch in Lake Erie,
W89-00030 5C

Feedback Dependence Between the Eutrophication Process and Changes in the Fish Community: The Theory of Ichthyoeutrophication (Sprzezenie zwrothe miedzy procesum eutrofizacji a zmianami zespolu ryb. Tesri ichtioeutrofizacji),
W89-00031 5C

Natural Degradation Ability of Lakes and the Role of Drainage Area in the Process (Ocena naturalnej podatnosci jezior na degradacje i rola zlewni u tym procesie),
W89-00032 2H

High Rates of Production and Mortality of Submerged Sparganium emersum Rehman during Its Short Growth Season in a Eutrophic Danish Stream,
W89-00099 2H

Loss of Seagrass in Cockburn Sound, Western Australia: II. Possible Causes of Seagrass Decline,
W89-00116 5C

Growth Strategies and Distribution of Isoetids in Scottish Freshwater Lochs,
W89-00129 5C

Lake Enrichment by Submersed Macrophytes: A Norwegian Whole-Lake Experience with Elodea canadensis,
W89-00131 2H

Seasonal Composition, Biomass and Primary Productivity of the Phytoplankton in Lakitelek Backwater during 1980 and 1983,
W89-00144 2H

Modelling Research on the Production Cycle of Phytoplankton in the Southern Bight of the North Sea in Relation to Riverborne Nutrient Loads,
W89-00157 2L

Role of Sewage Effluent in the Accumulation of Macroalgal Mats on Intertidal Mudflats in Two Basins in Southern England,
W89-00159 5C

Use of Plant Micro-Nutrient and Chlorophyll Records as Indices of Eutrophication in Inshore Waters,
W89-00160 5A

Some Hydrochemical, Hydrobiological, and Ichthyological Features of Yugoslav Part of the Danube Lasting for Several Years (Einige hydrochemische, hydrobiologische und ichthyologische Eigenschaften der jugoslawischen Donaustrecke in mehrjahrigem Zeitraum),
W89-00165 5C

Effects of Acidification and Phosphorus Addition on Phytoplankton Biomass and Productivity in a Circum-Neutral Mesotrophic Lake Receiving Acid Precipitation,
W89-00179 2H

Community Grazing and the Regulation of In Situ Clearance and Feeding Rates of Planktonic Crustaceans in Lakes in the Kuokkel Area, Northern Sweden,
W89-00181 2H

Characteristics of Distribution and Migration of Phosphorus in Deposits of Dianchi Lake, (in Chinese),
W89-00200 5B

Nutrient Levels and the Development of Diatom and Blue-Green Blooms in a Shallow Australian Estuary,
W89-00211 2H

Effects of Increasing Salinity on a Cyanobacteria Bloom in the Potomac River Estuary,
W89-00231 2H

Contemporary Changes in Coastal Biocenoses of the Gdansk Bay (South Baltic), A Review,
W89-00254 2L

Qualitative and Quantitative Changes in Phytoplankton on the Background of Physicochemical Changes in the Water of Swietokrzyskie Lake in the Years 1977-1979,
W89-00258 5C

Factors Forming the Level and Dynamics of Nutrient Runoff from an Agricultural Watershed,
W89-00261 5B

Chlorophyll Relationships in Letowo and Szczytno Male Lakes, with Trout Cage Culture,
W89-00262 2H

Eutrophication of Lakes and Reservoirs: A Framework for Making Management Decisions,
W89-00439 5C

Delayed Nutrient Responses to the Liming of Lake Gardsjon, Sweden,
W89-00441 5G

Intermittent Destratification: A Therapy Measure against Cyanobacteria in Lakes,
W89-00639 5G

Increased Phytoplankton Primary Production in the Marsdiep Area (Western Dutch Wadden Sea),
W89-00674 5C

Seasonal Changes of the Profundal Macrobenthic Community in a Polluted Lake,
W89-00693 5C

Eutrophication and Benthic Fauna of Three Mountain Lakes (Eutrophisation et Faune Benthique de Trois Lacs de Montagne),
W89-00695 5C

Attached Algae of the Clyde and Garnock Estuaries,
W89-00807 5C

Phytoplankton Ecology of the Firth of Clyde Sea-Lochs Striven and Fyne,
W89-00813 2L

Benthos of the Deeper Sediments of the Firth of Clyde, with Particular Reference to Organic Enrichment,
W89-00820 5C

Tropical Eutrophic Lake Modeling and Parameter Discrimination,
W89-00872 2H

Response of Benthic Meiofauna to Nutrient Enrichment of Experimental Marine Ecosystems,
W89-01033 5C

Myxococcal Predation on Cyanobacterial Populations: Nutrient Effects,
W89-01050 2H

Phytoplankton and Reversed Eutrophication in Lake Malaren, Central Sweden, 1965-1983,
W89-01188 5G

Modeling Blue-Green Algal Blooms in the Lower Neuse River,
W89-01225 5C

Lake Response Modeling Using Biologically Available Phosphorus,
W89-01236 5C

EVALUATION

Evaluation of the Reliability of Wave-Protection Slab Revetments of Embankment Slopes,
W89-01176 8D

EVAPORATION

Evaporation from Mackenzie Delta Lakes, N.W.T., Canada,
W89-00438 2D

Analyses of Equations for Free Water Evaporation Estimates,
W89-00705 2D

EVAPORATION RATE

Estimation of Bare Soil Evaporation from Airborne Measurements,
W89-00352 7B

EVAPOTRANSPIRATION

Evapotranspiration of a Willow Carr in Summer,
W89-00125 2D

Estimation of Bare Soil Evaporation from Airborne Measurements,
W89-00352 7B

Determination of Water Use Efficiency of Veld in the Central Orange Free State from Evapotranspiration Measurements (Bepaling van Waterverbruiksdoeltreffendheid van Veld in die

Sentrale Oranje-Vrystaat Vanaf Evapotranspirasiemetings),
W89-00934 2D

Composite Method for Estimating Annual Actual Evapotranspiration,
W89-01141 2D

EXCAVATION
Calculation of Seismic Safety of Tunnels During Blasting,
W89-00037 8E

Prospects of Improving the Prediction of the Hazard of Rock Bursts During Tunneling,
W89-00038 8E

Excavation of Heavy Soils by Dredges,
W89-00068 8H

Automation of Conveyor Transport at the Construction Site of Earth Dams,
W89-01173 8H

EXOPOLYSACCHARIDE
Isolation, Identification and Characterisation of Filamentous and Floc-Forming Bacteria from Activated Sludge Flocs,
W89-00648 5D

EXPERIMENTAL DESIGN
Sampling Strategies and Associated Errors in Estimating Epilimnetic Chlorophyll in Eutrophic Lakes,
W89-01242 2H

EXTREME-VALUE THEORY
Extreme-Value Theory Model for Dependent Observations,
W89-01208 7C

FACTOR ANALYSIS
Regionalization of Daily Rainfall in Kenya by Means of Common Factor Analysis,
W89-00473 2B

Definition of a Model for Monitoring the Chemical and Chemical-Physical Characteristics of Deep Drinking Waters,
W89-00927 7C

FALLOUT
Use of Mires in Monitoring the Atmospheric Deposition of Heavy Metals,
W89-00123 5A

Investigation of Transport-Processes along the Elbe River Using Chernobyl Radionuclides as Tracers,
W89-00636 5B

FARM WASTES
Animal Wastes Media for Spirulina Production,
W89-00136 5D

FARMING
Estimation of Phytoplankton Biomass and Production, and Organic Matter Decomposition in Three Small Field-Ponds,
W89-00252 2H

FATE OF POLLUTANT
Comparison of Chemical Biodegradation Rates in BOD Dilution and Natural Waters,
W89-01158 5B

FATE OF POLLUTANTS
Bacterial Degradation of Crude Oil Water Pollutants in Danube Water (Die bakterielle Degradation von Erdolkohlenwasserstoffen im Donauwasser),
W89-00168 5B

Model Ecosystems as a Tool in Freshwater and Marine Research,
W89-00180 5B

Cycling of Inorganic and Organic Sulfur in Peat from Big Run Bog, West Virginia,
W89-00208 2H

Effects of Co-Occurring Aromatic Hydrocarbons on Degradation of Individual Polycyclic Aromatic Hydrocarbons in Marine Sediment Slurries,
W89-00339 5B

Microbial Degradation of Xenobiotic, Aromatic Pollutants in Humic Water,
W89-00344 5B

Evaluation of the 'Fugacity' (FEQUM) and the 'EXAMS' Chemical Fate and Transport Models: A Case Study on the Pollution of the Norrsundet Bay (Sweden),
W89-00357 5B

Investigations of Chlorinated Thiophenes: A Group of Bioaccumulable Compounds Identified in the Effluents from Kraft Bleaching,
W89-00360 5B

Environmental Fate of Chloroguaiacols and Chlorocatechols,
W89-00369 5B

Fate of Spent Bleach Liquor Material in Receiving Waters: Characterization of Chloroorganics in Sediments,
W89-00371 5B

Contribution of Plasmids to Naphthalene Catabolism in Sediment Bacteria,
W89-00378 5B

Fate of Alachlor during Treatment of Public Water Supplies,
W89-00395 5F

Load Allocation for Toxics Using Monte Carlo Techniques,
W89-00514 5G

Effects of Discontinuing Disinfection on a Receiving Water,
W89-00515 5D

Estimate of the Variability in Biotransformation Kinetics of Xenobiotics in Natural Waters by Aufwuchs Communities,
W89-00559 5B

Formation of Oxygen Species and Their Reactions with Organic Chemicals in Aqueous Solution,
W89-00575 5B

Bioavailability of Polychlorinated Dibenzo-p-dioxins and Dibenzofurans from Contaminated Wisconsin River Sediment to Carp,
W89-00583 5B

Photochemical Reaction of Biphenyl in Water Containing Nitrite or Nitrate Ion,
W89-00593 5B

Hydrocarbon Fuel Spill Dispersion on Water: A Literature Review,
W89-00598 5B

Degradation of Bisphenol A in Natural Waters,
W89-00600 5B

Biotic and Abiotic Degradation Rates of Methyl Parathion in Freshwater and Estuarine Water and Sediment Samples,
W89-00601 5B

Long-term Study of Ecosystem Contamination with 2,3,7,8-Tetrachlorodibenzo-p-dioxin,
W89-00603 5B

Biogeochemistry of Benz(a)anthracene at the Sediment-Water Interface,
W89-00612 5B

Evaluation of Aquatic Environmental Fate of 2,4,6-Trichlorophenol with a Mathematical Model,
W89-00616 5B

Studies of the Oxidative Photoinduced Degradation of Silicones in the Aquatic Environment,
W89-00617 5B

Distribution of Arsenic in the Sediments and Biota of Hilo Bay, Hawaii,
W89-00677 5B

Three-Dimensional Radial Dispersion in a Variable Velocity Flow Field,
W89-00715 5B

Conjugal Transfer of R68.45 and FP5 between Pseudomonas aeruginosa Strains in a Freshwater Environment,
W89-00728 5B

Effects of Acidification on Mercury Methylation, Demethylation, and Volatilization in Sediments from an Acid-Susceptible Lake,
W89-00731 5B

Degradation of Low-Toxicity Oil-Based Drilling Mud in Benthic Sediments around the Beatrice Oilfield,
W89-00792 5B

Numerical Modeling of Sorption Kinetics of Organic Compounds to Soil and Sediment Particles,
W89-00981 5B

Contaminant Transport in Fractured Porous Media: Steady State Solutions by a Boundary Integral Method,
W89-00982 5B

Simulation Model for Biotransformation of Xenobiotics and Chemotaxis in Soil Columns,
W89-00989 5B

Sorption and Desorption Dynamics of Aroclor 1242 to Natural Sediment,
W89-00991 5B

Statistical Correlations for Predicting the Partition Coefficient for Nonpolar Organic Contaminants Between Aquifer Organic Carbon and Water,
W89-00992 5B

Utility of Laboratory Streams for Ecosystem Toxicity Studies,
W89-01059 5B

Reactivity of the Carbonate Radical with Aniline Derivatives,
W89-01088 5B

Aerobic Biodegradation of Natural and Xenobiotic Organic Compounds By Subsurface Microbial Communities,
W89-01090 5B

Sorption of Cationic Oligomers on Sediments,
W89-01094 5B

Pesticides: A Continuing Dilemma,
W89-01122 5B

Studies on the Degradation of Synthetic Detergents by Sewage,
W89-01159 5B

Sorption and Degradation of Aldicarb and Its Oxidation Products in a Soil-Water Flow System as a Function of pH and Temperature,
W89-01164 5B

Estimating Soil/Sediment Partition Coefficients for Organic Compounds by High Performance Reverse Phase Liquid Chromatography,
W89-01223 5B

FATE OF POLLUTANTS

Fate and Transport of Organics in Soil: Model Predictions and Experimental Results,
W89-01239 5B

Numerical Transport Model for Oxygen- and Nitrate-Based Respiration Linked to Substrate and Nutrient Availability in Porous Media,
W89-01251 5D

FATHEAD MINNOW

Photo-induced Toxicity of Polycyclic Aromatic Hydrocarbons to Larvae of the Fathead Minnow (Pimephales promelas),
W89-00595 5C

Effects of Acute Exposure to Acidified Water on the Behavorial Response of Fathead Minnows, Pimephales Promelas, to Alarm Substance (Schreckstoff),
W89-01092 5C

Comparative Sensitivities of Bluegill, Channel Catfish and Fathead Minnow to pH and Aluminum,
W89-01098 5C

FATHEAD MINNOWS

Avoidance of a Water-Soluble Fraction of Coal Liquid by Fathead Minnows,
W89-00321 5C

Leaching of Retorted Oil Shale: Assessing the Toxicity to Colorado Squawfish, Fathead Minnows, and Two Food-Chain Organisms,
W89-00329 5C

Acute and Chronic Toxicity of Triphenyltin Hydroxide to Fathead Minnows (Pimephales promelas) Following Brief or Continuous Exposure,
W89-01057 5C

Evaluation and Comparison of Two Short-Term Fathead Minnow Tests for Estimating Chronic Toxicity,
W89-01224 5A

FAUNA

Toxicity of an Anionic Detergent to the Spawn and Larvae of Anurans (Amphibia),
W89-00139 5C

Faunas of Land-Locked Lagoons: Chance Differences and the Problems of Dispersal,
W89-00141 2L

FEEDING

Community Grazing and the Regulation of In Situ Clearance and Feeding Rates of Planktonic Crustaceans in Lakes in the Kuokkel Area, Northern Sweden,
W89-00181 2H

FEEDING RATES

Clearance of Bacteria-Sized Particles by Natural Populations of Nanoplankton in the Chesapeake Bay Outflow Plume,
W89-01032 2L

Interspecific, Seasonal and Diel Variations in Zooplankton Trypsin and Amylase Activities in Kosterfjorden, Western Sweden,
W89-01040 2L

FEEDLOT RUNOFF

Evaluation of Vegetation Filter Strips as a Best Management Practice for Feed Lots,
W89-01125 5G

FENS

Decomposition in an Ombrotrophic Bog and a Minerotrophic Fen in Minnesota,
W89-00742 2H

FERTILIZATION

Effects of Polyculture and Manure Fertilization on Water Quality and Heterotrophic Productivity in Macrobrachium rosenbergii Ponds,
W89-00327 8I

Assessing Effects of Soil Pollution Control Residuals on Soil Chemistry Properties,
W89-01140 5E

FERTILIZERS

Problem with Nitrates,
W89-00965 5B

FIBERGLASS FILTERS

Wound Fiberglass Depth Filters as a Less Expensive Approach for the Concentration of Viruses from Water,
W89-00279 5A

FICKIAN MODEL

Modified Fickian Model for Solute Uptake by Runoff,
W89-00486 5B

FIELD TESTING

Making the Most of Field-Measurable Ground Water Quality Parameters,
W89-00939 7B

FIELD TESTS

National Field Evaluation of a Defined Substrate Method for the Simultaneous Enumeration of Total Coliforms and Escherichia coli from Drinking Water: Comparison with the Standard Multiple Tube Fermentation Method,
W89-00337 5A

FILTER MEDIA

Novel Approach for Modifying Microporous Filters for Virus Concentration from Water,
W89-00332 5A

Review of Rock Filters for the Upgrade of Lagoon Effluents,
W89-01235 5D

FILTERS

Novel Approach for Modifying Microporous Filters for Virus Concentration from Water,
W89-00332 5A

Evaluation of Disposable Membrane Filter Units for Sorptive Losses and Sample Contamination,
W89-00623 5A

Effects of Biofilter Media on the Performance of Anaerobic Hybrid Reactors,
W89-00626 5D

Microporous Filters with Oxidizing Power for Iron and Manganese Removal from Water,
W89-00889 5F

Empirical Correlation for Estimating Pressure Drop Across Clogged Filters,
W89-00924 5F

FILTRATION

Performance of Vinyl Core Media Trickling Filter Plant for Secondary Treatment of Municipal Wastewater,
W89-00502 5D

Compressible Cake Filtration: Monitoring Cake Formation and Shrinkage Using Synchrotron X-rays,
W89-00512 5D

Evaluation of Disposable Membrane Filter Units for Sorptive Losses and Sample Contamination,
W89-00623 5A

Microporous Filters with Oxidizing Power for Iron and Manganese Removal from Water,
W89-00889 5F

Filtration Technologies for Water Treatment,
W89-01099 5F

FINANCIAL FEASIBILITY

Copper, Nickel, and Chrome Recovery in a Jobshop to Eliminate Waste Treatment and Sludge Disposal,
W89-00993 5D

FINANCING

Funding Reserve Capacity in Wastewater Systems,
W89-00506 5D

Developer Financing of Public Wastewater Service Infrastructure,
W89-00507 5D

Financing Strategies for Small Systems,
W89-01113 5F

FINGERTIP COUNTS

Fecal Coliform Fingertip Count: A Potential Method for Evaluating the Effectiveness of Low Cost Water Supply and Sanitation Initiatives,
W89-00379 5G

FINITE ELEMENT METHOD

Finite Element Computation of Shape Factors for Kirkham's Piezometer Tube Method for Hydraulic Conductivity of Saturated Soil,
W89-00911 2G

FINLAND

Modelling the Effects of Acid Deposition: Estimation of Long-Term Water Quality Responses in Forested Catchments in Finland,
W89-00894 5B

FIRN

Nitrate Trace Determinations in Snow and Firn Core Samples of Ice Shelves at the Weddell Sea, Antarctica,
W89-01258 5B

FIRTH OF CLYDE

Geography of the Estuary and Firth of Clyde,
W89-00798 2L

Geological and Geomorphological Setting of the Estuary and Firth of Clyde,
W89-00799 2L

Climate of the Estuary and Firth of Clyde,
W89-00800 2L

Fresh Water Inflows to the Firth of Clyde,
W89-00801 2L

Clyde Sea Hydrography,
W89-00802 2L

Water Movement and the Simulation of Storm Surges in the Firth of Clyde,
W89-00803 2L

Effluent Disposal and the Physical Environment,
W89-00804 5E

Bioturbation, Microbial Activity and Sediment Properties in an Estuarine Ecosystem,
W89-00806 2L

Epilithic Diatoms of the Clyde Estuary,
W89-00808 2L

Status of Fish Populations in the Clyde Estuary,
W89-00809 2L

Recent Changes in Numbers of Waders on the Clyde Estuary, and Their Significance for Conservation,
W89-00810 5C

Patterns of Association Between Birds and Invertebrates in the Clyde Estuary,
W89-00811 2L

Seasonal Studies on the Phytoplankton and Primary Production in the Inner Firth of Clyde,
W89-00812 2L

Phytoplankton Ecology of the Firth of Clyde Sea-Lochs Striven and Fyne,
W89-00813 2L

Zooplankton Investigations in the Firth of Clyde,
W89-00814 2L

Ecology of Macroalgae in the Firth of Clyde,
W89-00815 2L

Seaweed-Associated Animal Communities in the Firth of Clyde, with Special Reference to the Population Biology of the Amphipod Hyale nilssoni (Rathke),
W89-00816 2L

Long-Term Changes in Some Benthic Species in the Firth of Clyde, with Particular Reference to Tellina tenuis da Costa,
W89-00817 5C

Biology of Harpacticoid Copepods in the Meiofauna of Shallow Subtidal Sands,
W89-00818 2L

Benthic Fauna of Sandy Bays, with Particular Reference to Irvine Bay,
W89-00819 5C

Benthos of the Deeper Sediments of the Firth of Clyde, with Particular Reference to Organic Enrichment,
W89-00820 5C

Mud-Burrowing Megafauna of the Clyde Sea Area,
W89-00821 2L

Population Dynamics of Seabirds in the Firth of Clyde,
W89-00822 2L

Trace Metals in the Common Mussel Mytilus edulis (L.) in the Clyde Estuary,
W89-00823 5B

Use of the Clyde Estuary and Firth for the Disposal of Effluents,
W89-00824 5E

Biology and Management of Herring and Other Pelagic Fish Stocks in the Firth of Clyde,
W89-00825 2L

Recent Changes in the Status of Some Clyde Vertebrates,
W89-00826 5C

Conservation of Natural Resources,
W89-00827 6E

Migratory Salmonids of the Estuary and Firth of Clyde,
W89-00828 5G

Distribution of Plaice Eggs and Larvae in the Clyde Sea Area,
W89-00829 2L

Saltmarshes of the Firth of Clyde,
W89-00830 2L

FISH

Eutrophication Effects of Prey Size and Food Available to Yellow Perch in Lake Erie,
W89-00030 5C

Biochemical Changes in the Liver of Fish, Tilapia mossambica (Peters), during Continuous Exposure to Monocrotophos,
W89-00085 5C

Toxicity Bioassay of Technical and Commercial Formulations of Carbaryl to the Freshwater Catfish, Clarias batrachus,
W89-00086 5C

Acclimatization of Roach, Rutilus rutilus (L.), to Toxic Components of Kraft Pulp Mill Effluents,
W89-00087 5C

Effects of Fish Nests on Pattern and Zonation of Submersed Macrophytes in a Softwater Lake,
W89-00092 2H

Monitoring of Mercury Pollution in Dutch Coastal Waters by Means of the Teleostean Fish Zoarces Viviparus,
W89-00150 5C

Limnocorral Experiments in a Eutrophic Lake - Effects of Fish on the Planktonic and Chemical Conditions,
W89-00253 2H

Effects of Disturbance and Severe Seasonal Fluctuations in Environmental Conditions on North Temperate Shallow-water Fish Assemblages,
W89-00282 2L

Periphyton, Benthic Invertebrates and Fishes as Biological Indicators of Water Quality in the East Branch Brandywine Creek,
W89-00314 5A

Risk Analysis for Fish Diversion Experiments: Pumped Intake Systems,
W89-00318 8I

Microhabitat Use by an Assemblage of California Stream Fishes: Developing Criteria for Instream Flow Determinations,
W89-00319 6D

Reduction of a Dolly Varden Population and Macrobenthos after Removal of Logging Debris,
W89-00322 4C

Does pH Affect Fish Species Richness when Lake Area is Considered,
W89-00324 2H

Sublethal Effects of Chlorinated Phenols and Resin Acids on Rainbow Trout (Salmo gairdneri),
W89-00364 5C

Effects of Pulp Mill Effluents on Skeletal Parameters in Fish: A Progress Report,
W89-00365 5C

Effects of Pulp Mill Effluent on a Baltic Coastal Fish Community,
W89-00366 5C

Effects of a Bleached Pulp Mill Effluent on Growth and Gonad Function in Baltic Coastal Fish,
W89-00367 5C

Homing of Adult Chinook Salmon after Brief Exposure to Whole and Dispersed Crude Oil,
W89-00375 5C

Comparison of Laboratory and Field Observations of Fish Exposed to the Herbicides Molinate and Thiobencarb,
W89-00376 5C

Effects of Season and Substrate on Availability of Drift for Fish in a Small Warmwater Stream,
W89-00400 2H

Depressed Mercury Levels in Biota from Acid and Metal Stressed Lakes Near Sudbury, Ontario,
W89-00442 5B

Effects of Six Heavy Metals on Hatching Eggs and Survival of Larva of Marine Fish, (in Chinese),
W89-00533 5C

Bioavailability of Polychlorinated Dibenzo-p-dioxins and Dibenzofurans from Contaminated Wisconsin River Sediment to Carp,
W89-00583 5B

Survey of Mercury, Lead and Cadmium in Muscle of British Freshwater Fish,
W89-00587 5B

Effects of Lindane and Atropine Sulphate on the Tissues of the Fish, Anabas testudineus (Bloch): A Chronotoxicological Approach,
W89-00594 5C

Age to PCB Concentration Relationship with the Striped Bass (Morone saxatilis) in the Hudson River and Long Island Sound,
W89-00597 5B

Routine Determination of Polychlorinated Biphenyl Residues in Fish and Shellfish in Taipei County,
W89-00605 5A

Polybrominated Biphenyl Ethers in Marine Fish, Shellfish, and River and Marine Sediments in Japan,
W89-00610 5B

Comparison of Robust Bayes and Classical Estimators for Regional Lake Models of Fish Response to Acidification,
W89-00713 5C

Fish, Fleas and Phytoplankton,
W89-00851 5C

Sea-Surface Microlayer of Puget Sound: Part I: Toxic Effects on Fish Eggs and Larvae,
W89-00853 5C

Sea-Surface Microlayer of Puget Sound: Part II: Concentrations of Contaminants and Relation to Toxicity,
W89-00854 5C

Contaminant Concentrations and Toxicity of Sea-Surface Microlayer Near Los Angeles, California,
W89-00857 5C

Some Biological Aspects of Liza abu (Heckel) mugilidae, in AL-Daoodi Drain, (Baghdad, Iraq),
W89-00890 2H

Fish and Fisheries of Regulated Rivers in the UK,
W89-00960 8I

Effects of Discharge Fluctuation and the Addition of Fine Sediment on Stream Fish and Macroinvertebrates Below a Water-Filtration Facility,
W89-01061 5C

Estimating the Acute Toxicity of Waterborne Chemicals in Trout from Measurements of Median Lethal Dose and the Octanol-Water Partition Coefficient,
W89-01095 5C

Comparative Sensitivities of Bluegill, Channel Catfish and Fathead Minnow to pH and Aluminum,
W89-01098 5C

Mercury in Freshwater Fish and Clams from the Cerro Prieto Geothermal Field of Baja California, Mexico,
W89-01153 5B

Branchial and Renal Pathology in the Fish Exposed Chronically to Methoxy Ethyl Mercuric Chloride,
W89-01156 5C

Fecundity Dynamics of Khramulya, Varicorhinus capoeta sevangi, in Relation to the Changing Environment of Lake Sevan,
W89-01194 2H

FISH BEHAVIOR
Influence of Temperature on Microhabitat Choice by Fishes in a California Stream,
W89-00027 2H

Diurnal Distribution and Behavioral Responses of Fishes to Extreme Hypoxia in an Amazon Floodplain Lake,
W89-00331 2H

Effects of Acute Exposure to Acidified Water on the Behavorial Response of Fathead Minnows, Pimephales Promelas, to Alarm Substance (Schreckstoff),
W89-01092 5C

FISH CONSERVATION
Feedback Dependence Between the Eutrophication Process and Changes in the Fish Community: The Theory of Ichthyoeutrophication (Sprzezenie zwrothe miedzy procesum eutrofizacji a zmianami zespolu ryb. Tesri ichtioeutrofizacji),
W89-00031 5C

Preservation of Natural Fish Reproduction during Hydrotechnical Construction on Rivers,
W89-00069 8I

FISH DEVELOPMENT
Developmental Defects in Pelagic Fish Embryos from the Western Baltic,
W89-00315 5C

FISH DISEASES
Tumor Frequencies and Contaminant Concentrations in Brown Bullheads from an Industrialized River and a Recreational Lake,
W89-00028 5C

FISH EGGS
Fecundity Dynamics of Khramulya, Varicorhinus capoeta sevangi, in Relation to the Changing Environment of Lake Sevan,
W89-01194 2H

FISH ESTABLISHMENT
Limnocorral Experiments in a Eutrophic Lake - Effects of Fish on the Planktonic and Chemical Conditions,
W89-00253 2H

FISH HATCHERIES
Exploited Fish and Shellfish Species in the Moray Firth,
W89-00779 2L

Phytoplankton Ecology of the Firth of Clyde Sea-Lochs Striven and Fyne,
W89-00813 2L

Biology and Management of Herring and Other Pelagic Fish Stocks in the Firth of Clyde,
W89-00825 2L

FISH MANAGEMENT
Preservation of Natural Fish Reproduction during Hydrotechnical Construction on Rivers,
W89-00069 8I

Endangered Woundfin and Water Management in the Virgin River, Utah, Arizona, Nevada,
W89-00311 6G

Changes in the Fish Fauna of the Bot River Estuary in Relation to Opening and Closure of the Estuary Mouth,
W89-00665 2L

FISH MIGRATION
Susceptibility of Young-of-the-Year Fishes to Downstream Displacement by Flooding,
W89-00295 2H

Effects of Stream Cleaning on Juvenile Coho Salmon and Dolly Varden in Southeast Alaska,
W89-00374 2H

Homing of Adult Chinook Salmon after Brief Exposure to Whole and Dispersed Crude Oil,
W89-00375 5C

FISH PASSAGES
Plunging and Streaming Flows in Pool and Weir Fishways,
W89-00904 2E

Hydropower Development on Rivers in Scotland,
W89-00952 8C

FISH PHYSIOLOGY
Growth and Conversion Efficiency of the Catfish Heteropneustes fossilis (Bloch) Exposed to Sub-Lethal Concentrations of Sodium Pentachlorophenate,
W89-00243 5C

Physiological Effects on Coho Salmon and Steelhead of Exposure to Suspended Solids,
W89-00292 5C

Physiological Disturbances in Fish Exposed to Bleached Kraft Mill Effluents,
W89-00363 5C

Effects of Organic Contaminants on Reproduction of the Starry Flounder Platichthys stellatus in San Francisco Bay. I. Hepatic Contamination and Mixed-Function Oxidase (MFO) Activity During the Reproductive Season,
W89-00385 5C

Comparison of the Physiological Condition of the Southern Mullet Liza richardsoni (Smith), in a Closed Estuary and the Sea,
W89-00663 2L

Sea-Surface Microlayer of Puget Sound: Part I: Toxic Effects on Fish Eggs and Larvae,
W89-00853 5C

Toxicity of Sea-Surface Microlayer: Effects of Hexane Extract on Baltic Herring (Clupea harengus) and Atlantic Cod (Gadus morhua) Embryos,
W89-00856 5C

Hepatic Lesions in English Sole (Parophrys vetulus) from Commencement Bay, Washington (USA),
W89-00859 5C

FISH PONDS
Testing the Secondary Treatment of Effluents from the 'Police' Chemical Plant in Carp Ponds,
W89-00255 5D

FISH POPULATIONS
Fish Communities in Reservoirs in Southern Brazil (Comunidades de Peixes de Reservatorios no Sul do Brasil),
W89-00011 2H

Spatial and Temporal Variability of the Index of Biotic Integrity in Three Midwestern Streams,
W89-00026 2E

Longitudinal Changes in Fish Assemblages and Water Quality in the Willamette River, Oregon,
W89-00029 2H

Some Hydrochemical, Hydrobiological, and Ichthyological Features of Yugoslav Part of the Danube Lasting for Several Years (Einige hydrochemische, hydrobiologische und ichthyologische Eigenschaften der jugoslawischen Donaustrecke in mehrjahrigem Zeitraum),
W89-00165 5C

Attempt to Estimate the Fish Stock and the Sustainable Yield of Lake Ziway and Lake Abaya, Ethiopian Rift Valley,
W89-00178 2H

Impacts of Navigation on Riverine Fish Production in the United States,
W89-00248 6G

Fish Production in the Kanawha River and its Relation To Barge Traffic,
W89-00249 6G

Comparison of the Physiological Condition of the Southern Mullet Liza richardsoni (Smith), in a Closed Estuary and the Sea,
W89-00663 2L

Mass Mortality of Fish Associated with Low Salinity Conditions in the Bot River Estuary,
W89-00664 2L

Changes in the Fish Fauna of the Bot River Estuary in Relation to Opening and Closure of the Estuary Mouth,
W89-00665 2L

Terrestrial Bioaccumulation Potential of Phenolic Compounds,
W89-00998 5B

Streamflow Regulation and Fish Community Structure,
W89-01053 4A

FISH STOCKING
Attempt to Estimate the Fish Stock and the Sustainable Yield of Lake Ziway and Lake Abaya, Ethiopian Rift Valley,
W89-00178 2H

FISHERIES
Feedback Dependence Between the Eutrophication Process and Changes in the Fish Community: The Theory of Ichthyoeutrophication (Sprzezenie zwrothe miedzy procesum eutrofizacji a zmianami zespolu ryb. Tesri ichtioeutrofizacji),
W89-00031 5C

Sea and Fresh Waters,
W89-00797 2L

Geography of the Estuary and Firth of Clyde,
W89-00798 2L

Interannual Variability in Climate and Fisheries in Tasmania,
W89-00847 2A

Fish and Fisheries of Regulated Rivers in the UK,
W89-00960 8I

Interjurisdictional Management in Chesapeake Bay Fisheries,
W89-01073 6E

Possibility of Using Radioactively Polluted Waterbodies for Fish Culture,
W89-01193 3C

FISHERIS
State of the Ichthyofauna in Istrinsk Reservoir Since Its Conversion into a Recreational Water,
W89-01191 2H

FISHKILL
Summary of Reported Fish Kills in Kansas During 1982,
W89-00393 5C

FIXED FILM
Anaerobic Treatment of Leachate Using Fixed Film and Sludge Bed Systems,
W89-01238 5D

FJORDS
Effect of Light Regime upon Growth Rate and Chemical Composition of a Clone of Skeleton-

ema costatum from the Trondheimsfjord, Norway,
W89-00212 2L

Tidal Transport of Planktonic Copepods across the Sill of a British Columbia Fjord,
W89-00221 2L

Short-Term Variations in the Zooplankton Community Related to Water Exchange Processes in the Gullmar Fjord, Sweden,
W89-00228 2H

Physicochemical and Geotechnical Characteristics of Recent Saguenay Fjord Sediments,
W89-00390 2J

Sedimentation of Particulate Material in Two Shallow, Land-Locked Fjords in Western Norway,
W89-01008 2J

Population Genetics of Mytilus edulis (L.) from Oslofjorden, Norway in Oil-Polluted and Non Oil-Polluted Water,
W89-01009 5C

Large-Scale and Long-Term Variations in the Zooplankton Community of the Gullmar Fjord, Sweden, in Relation to Advective Processes,
W89-01038 2L

FLAGELLATES
Feeding of a Freshwater Flagellate, Bodo saltans, on Diverse Bacteria,
W89-00381 2H

FLOATING PLANTS
Chromium Removal from Water by Three Species of Duckweeds,
W89-00109 5D

FLOCCULATION
Growth Kinetics of Hydroxide Flocs,
W89-00428 5F

Flocculent Settling above Zone Settling Interface,
W89-00484 5E

Isolation, Identification and Characterisation of Filamentous and Floc-Forming Bacteria from Activated Sludge Flocs,
W89-00648 5D

Flocculation and De-Flocculation of Suspended Matter in Estuaries,
W89-00671 2L

FLOOD CONTROL
River Improvement Planning for Flood Protection in the Kiso River Basin until the Meiji Era, (in Japanese),
W89-00204 4A

Inhabitants' Life in the Lowland of the Kiso, Nagara and Ibi Rivers, (in Japanese),
W89-00205 4A

Multicriterion Stormwater Management Methods,
W89-00302 4A

Ex Post Analysis of Flood Control: Benefit-Cost Analysis and the Value of Information,
W89-00983 6C

Developing Release Schedules for a Gated Spillway,
W89-01006 8A

FLOOD DATA
Generalized Method of Moments Applied to LP3 Distribution,
W89-00901 2E

Assessment of Flood Frequency Models Using Empirical Distribution Function Statistics,
W89-00976 2E

FLOOD DISCHARGE
Flow Capacity of Culverts on Oregon Coast Range Forest Roads,
W89-00878 8B

FLOOD FLOW
Generalized Method of Moments Applied to LP3 Distribution,
W89-00901 2E

FLOOD FORECASTING
Location-Invariant Plotting Positions for PWM Estimation of the Parameters of the GEV Distribution,
W89-00351 2E

Variations of Runoff in the High Plains Section of the Smoky Hill Drainage, 1951-1980,
W89-00394 2A

Maximum Likelihood Criterion for Use With Data Collected at Unequal Time Intervals,
W89-00723 2E

Generalized Method of Moments Applied to LP3 Distribution,
W89-00901 2E

Assessment of Flood Frequency Models Using Empirical Distribution Function Statistics,
W89-00976 2E

Operational Models for Flood Calculations,
W89-01030 2A

Identification of a Multiple Input, Single Output, Linear, Time Invariant Model for Hydrological Forecasting,
W89-01209 7C

FLOOD FREQUENCY
Location-Invariant Plotting Positions for PWM Estimation of the Parameters of the GEV Distribution,
W89-00351 2E

Use of Map Analysis to Elucidate Flooding in an Australian Riparian River Red Gum Forest,
W89-00722 2E

Confidence Intervals for Flood Events Under a Pearson 3 or Log Pearson 3 Distribution,
W89-00879 7C

Assessment of Flood Frequency Models Using Empirical Distribution Function Statistics,
W89-00976 2E

Methods and Merits of Regional Flood Frequency Analysis,
W89-01020 2E

Application of Probability Weighted Moments in Estimating the Parameters of the Pearson Type Three Distribution,
W89-01198 7C

Determination of Probability Weighted Moments with the Incorporation of Extraordinary Values into Sample Data and Their Application to Estimating Parameters for the Pearson Type Three Distribution,
W89-01199 7C

FLOOD HYDROGRAPHS
Regression Estimates for Topological-Hydrograph Input,
W89-00304 2E

FLOOD PEAK
Multicriterion Stormwater Management Methods,
W89-00302 4A

Drainage Basin Peak Discharge Rating Curve,
W89-00913 2E

FLOOD PLAINS
Effect of the Hydrological Regime on Primary Production in the Main Stream and the Side Arms of the River Danube,
W89-00162 2H

Use of Map Analysis to Elucidate Flooding in an Australian Riparian River Red Gum Forest,
W89-00722 2E

FLOOD PROTECTION
River Improvement Planning for Flood Protection in the Kiso River Basin until the Meiji Era, (in Japanese),
W89-00204 4A

Inhabitants' Life in the Lowland of the Kiso, Nagara and Ibi Rivers, (in Japanese),
W89-00205 4A

FLOOD WAVES
Regression Estimates for Topological-Hydrograph Input,
W89-00304 2E

FLOODING
Susceptibility of Young-of-the-Year Fishes to Downstream Displacement by Flooding,
W89-00295 2H

Use of Map Analysis to Elucidate Flooding in an Australian Riparian River Red Gum Forest,
W89-00722 2E

FLOODS
Hydrology of the Bot River Estuary,
W89-00654 2L

Confidence Intervals for Flood Events Under a Pearson 3 or Log Pearson 3 Distribution,
W89-00879 7C

Hydrological Changes and the River Regulation in the UK,
W89-00957 4A

FLORIDA
Hurricane-Related Morphodynamics and Implications for Hazard Mitigation, Perdido Key, Florida, U.S.A.,
W89-00291 6B

Creosote Compounds in Snails Obtained from Pensacola Bay, Florida, near an Onshore Hazardous-Waste Site,
W89-00611 5B

Alkalinity Regulation in Softwater Florida Lakes,
W89-00714 2H

FLOUNDER
Effects of Organic Contaminants on Reproduction of the Starry Flounder Platichthys stellatus in San Francisco Bay. I. Hepatic Contamination and Mixed-Function Oxidase (MFO) Activity During the Reproductive Season,
W89-00385 5C

FLOW
Hydrogeological and Hydrogeochemical studies of the Unsaturated Flow in a Gravel Aquifer: Part II. Results of Long Term Soil-hydrological Measurements (Hydrogeologische und Hydrochemische Untersuchungen in der Ungesaettigten Zone eines Kiesgrundwasserleiters: Teil II. Ergebnisse Langjaehriger Bodenhydrologischer Messungen),
W89-00503 2F

Derivation of Baseflow Recession Constant Using Computer and Numerical Analysis,
W89-01142 2E

Size of the Concrete Part of a Combined Apron below Low-head Outlet Works,
W89-01175 8B

FLOW AUGMENTATION
Impact of River Regulations on Invertebrate Communities in the U.K.,
W89-00959 4A

FLOW CHARACTERISTICS
Flow Regimes and Dynamic Equilibrium of Morphological Changes at Koycegiz Lake Inlet, Turkey,
W89-00449 8B

Annual Flow Statistics for Ungaged Streams in Idaho,
W89-00753 7C

Plunging and Streaming Flows in Pool and Weir Fishways,
W89-00904 2E

Generalized Rectangular Weir Equations,
W89-00905 8B

FLOW CONTROL
Flow Simulation Using Channel Network Model,
W89-00751 7B

Valves for Controlling Pressure, Flow and Level,
W89-01102 5F

FLOW FRICTION
Friction Factor Evaluation in Gravel-Bed Rivers,
W89-00898 8B

FLOW MEASUREMENT
Annual Flow Statistics for Ungaged Streams in Idaho,
W89-00753 7C

Mobile Flume for Circular Channel,
W89-00757 7B

Ultrasonic Flowmeter for Testing Units of Large Hydroelectric and Pumped-Storage Stations,
W89-01181 8C

FLOW PATTERN
Horizontal Round Buoyant Jet in Shallow Water,
W89-00902 5E

Plunging and Streaming Flows in Pool and Weir Fishways,
W89-00904 2E

Generalized Rectangular Weir Equations,
W89-00905 8B

FLOW PROFILES
Pumping Tests in Nonuniform Aquifers: The Radially Symmetric Case,
W89-01196 2F

FLOW RATES
Air and Water Flow: I. Horizontal Flow with an Arbitrary Flux Boundary Condition,
W89-00347 2G

Algal Studies of the River Ely, South Wales, U.K.: I. Phytoplankton,
W89-00678 2H

Annual Flow Statistics for Ungaged Streams in Idaho,
W89-00753 7C

FLOW REGIMES
Hydrological Changes and the River Regulation in the UK,
W89-00957 4A

FLOW RESISTANCE
Friction Factor Evaluation in Gravel-Bed Rivers,
W89-00898 8B

FLOW SYSTEM
Flow Simulation Using Channel Network Model,
W89-00751 7B

FLOW VELOCITY
Capacity of Ice-Covered Canals,
W89-01177 8B

FLUID MECHANICS
Extreme Pressures in Hydraulic-Jump Stilling Basins,
W89-00896 8B

FLUIDIZED BED PROCESS
Central Softening by Crystallization in a Fluidized-Bed Process,
W89-00421 5F

Operation of a Three-Phase Biofilm Fluidized Sand Bed Reactor for Aerobic Wastewater Treatment,
W89-00747 5D

FLUORESCENCE
Determination of Free Cyanide in Water by Released Fluorescence of a Dissociated Ternary Complex,
W89-00477 5A

FLUORIDES
Determination of Fluoride Ion in Well Waters of Eastwood School District, Wood County, Ohio,
W89-00684 5A

FLUOROMETRY
Determination of Free Cyanide in Water by Released Fluorescence of a Dissociated Ternary Complex,
W89-00477 5A

Microcomputer-Based Measurement of Algal Fluorescence as a Potential Indicator of Environmental Contamination,
W89-01157 5A

FLUSHING
Meteorologically Induced Flushing in Three U.S. East Coast Estuaries,
W89-00281 2L

FLUVIAL SEDIMENTS
Recent Transport of Metals in the River Severn as Recorded by the Sediments of Chelmarsh Reservoir, Shropshire, U.K.,
W89-00885 5B

FOAM SEPARATION
Simultaneous Removal of Heavy Metal Ions from Wastewater by Foam Separation Techniques,
W89-00265 5D

FOAM SITE
Provisional Diagenetic Model for pH in Anoxic Porewaters: Application to the FOAM Site,
W89-00767 2J

FOG
Determination of Mono- and Divalent Cations and Anions in Small Fog Samples by Ion Chromatography,
W89-00372 5A

Predictability of Two Moisture Sources in the Namib Desert,
W89-00455 2B

Fog Drip as a Source of Groundwater Recharge in Northern Kenya,
W89-00984 2F

FOOD CHAINS
Food Web Manipulation Without Nutrient Control: A Useful Strategy in Lake Restoration,
W89-00019 5G

Investigations of the Ecotoxicological Effect of an Herbicide in an Aquatic Model Ecosystem: II. Food Chain Significance and Pesticide Balance (Untersuchungen zur okotoxikologischen Wirkung eines Herbizids in einem aquatischen Modellokosystem: II. Nahrungskettenprobleme und Schadstoffbilanzierung),
W89-00175 5C

Model Ecosystems as a Tool in Freshwater and Marine Research,
W89-00180 5B

Loss Processes Influencing Growth of Planktonic Bacterial Populations in Lake Constance,
W89-00217 2H

Photoexcretion and Fate of Glycolate in a Hot Spring Cyanobacterial Mat,
W89-00342 2H

Patterns of Association Between Birds and Invertebrates in the Clyde Estuary,
W89-00811 2L

Variations in Polychlorinated Biphenyl Congener Composition in Eggs of Mediterranean Water Birds in Relation to their Position in the Food Chain,
W89-01056 5B

FOOD HABITATS
Zooplankton Community Grazing in a Hypertrophic Lake (Hartbeespoort Dam, South Africa),
W89-00220 2H

FOOD HABITS
Recurrence of Daphnia rosea in Lake Tahoe: Analysis of a Population Pulse,
W89-00216 2H

Loss Processes Influencing Growth of Planktonic Bacterial Populations in Lake Constance,
W89-00217 2H

Feeding of a Freshwater Flagellate, Bodo saltans, on Diverse Bacteria,
W89-00381 2H

Feeding and Swimming Behavior in Grazing Microzooplankton,
W89-00382 2H

Phagotrophic Phototrophs: The Ecological Significance of Mixotrophy,
W89-00384 2H

Patterns of Association Between Birds and Invertebrates in the Clyde Estuary,
W89-00811 2L

Discrimination between Algae and Artificial Particles by Freshwater and Marine Copepods,
W89-01047 2H

FOOD-PROCESSING WASTES
Characteristics of Soil after Pollution with Waste Waters from Olive Oil Extraction Plants,
W89-00602 5C

Liquid Effluents of the Fish Canning Industries of Rio de Janeiro State: Treatment Alternatives,
W89-00646 5D

FORAMINIFERA
Distribution of Agglutinated Foraminifera in Bottom Sediments of the Zhujiang River Estuary, (in Chinese),
W89-00203 2L

FORECASTING
Progress in Developing an Operational Snowmelt-Runoff Forecast Model with Remote Sensing Input,
W89-00891 2A

FOREST HYDROLOGY
Effects of Leaching and Whole-Tree Harvesting on Cation Budgets of Several Forests,
W89-01166 4C

Prediction of Snowmelt Rates in a Deciduous Forest,
W89-01203 2C

FOREST SOILS
Soil Processes and Sulfate Loss at the Hubbard Brook Experimental Forest,
W89-00206 5B

Changes in Soil Acidity in Two Forest Areas with Different Acid Deposition: 1920s to 1980s,
W89-00444 5B

Effects of Leaching and Whole-Tree Harvesting on Cation Budgets of Several Forests,
W89-01166 4C

FOREST WATERSHEDS
Development of Microorganisms on the Background of Organic Matter in Forest Ecosystem Waters,
W89-00080 2H

Soil Processes and Sulfate Loss at the Hubbard Brook Experimental Forest,
W89-00206 5B

Modelling the Effects of Acid Deposition: Estimation of Long-Term Water Quality Responses in Forested Catchments in Finland,
W89-00894 5B

Annual Elemental Input/Output Estimates for Two Forested Watersheds in Eastern Tennessee,
W89-01168 5B

FORESTS
Influence of Dusts from Chosen Industrial Plants on Particular Links of Forest Ecosystem of the Niepolomice Forest,
W89-00081 5C

Soil Processes and Sulfate Loss at the Hubbard Brook Experimental Forest,
W89-00206 5B

Effects of Disturbances Along Hydroelectrical Transmission Corridors Through Peatlands in Northern Manitoba, Canada.
W89-00436 4C

Use of Map Analysis to Elucidate Flooding in an Australian Riparian River Red Gum Forest,
W89-00722 2E

FORT WORTH
Water Pollution Control in Dallas-Fort Worth,
W89-01233 5G

FOULING
Moray Firth Marine Fouling Communities,
W89-00781 2L

FOUNDATION FAILURE
Cities Supported by Sticks in the Mud: A Variation on the Settlement of Land and Structures Caused by Ground Water Removal,
W89-01190 6E

FOUNDATION RACKS
Complex Geology Leads to an Unusual Design for the Lakhwar Dam,
W89-01005 8E

FOUNDATIONS
Some Results of Investigating the State of the Powerhouse of the Plyavinyas Hydroelectric Station,
W89-01180 8D

FRACTALS
Fractal Nature of River Networks,
W89-00975 2E

FRACTURE PERMEABILITY
Continuum Approach for Modeling Mass Transport in Fractured Media,
W89-00980 5B

Contaminant Transport in Fractured Porous Media: Steady State Solutions by a Boundary Integral Method,
W89-00982 5B

Hydrogeology of Two Saskatchewan Tills. I. Fractures, Bulk Permeability, and Spatial Variability of Downward Flow,
W89-01201 2F

Modeling of Tracer Spreading in a Fracture in which the Aperture Decreases with Depth in a Laminar Flow (Modelisation de la Propagation d'un Traceur dans une Fracture qui se Ferme Progressivement en Profondeur dans l'Hypothese d'un Ecoulement Laminaire Parallele),
W89-01214 2F

FRANCE
Sources of Watercourse Pollution in Italy and Mediterranean France, Assessed by Macrophytes,
W89-00563 5B

Optimization of the Production and Pumping Costs of the Nice Water Network (Optimisation de la Production et des Pompages sur le Reseau d'Eau de Nice),
W89-00922 5F

FREE WATER EVAPORATION
Analyses of Equations for Free Water Evaporation Estimates,
W89-00705 2D

FREEZE-THAW TESTS
Works of S. V. Shestoperov on Frost Resistance of Hydrotechnical Concrete,
W89-00061 8F

FRENCH GUIANA
Suspended Matter and Bottom Deposits in the Mahury Estuarine System (French Guiana): Environmental Consequences,
W89-00003 2J

FREQUENCY ANALYSIS
Analytical Simulation of Water System Capacity Reliability: 1. Modified Frequency-Duration Analysis,
W89-01240 5F

FREQUENCY DISTRIBUTION
Confidence Intervals for Flood Events Under a Pearson 3 or Log Pearson 3 Distribution,
W89-00879 7C

Application of Probability Weighted Moments in Estimating the Parameters of the Pearson Type Three Distribution,
W89-01198 7C

Determination of Probability Weighted Moments with the Incorporation of Extraordinary Values into Sample Data and Their Application to Estimating Parameters for the Pearson Type Three Distribution,
W89-01199 7C

FRICTION
Friction Factor Evaluation in Gravel-Bed Rivers,
W89-00898 8B

FRONTAL ZONE
Evolution and Fine Structure of a Long-Lived Meso-alpha-Scale Convective System in a Baiu Frontal Zone. Part II: Meso-gamma-Scale Characteristics of Precipitation,
W89-00416 2B

FROST HEAVING
Filterless Revetment of the Slopes of Dikes at Pumped-storage Station Reservoirs,
W89-00058 8A

Subsoil Investigation of Ice Lensing at the Calgary, Canada, Frost Heave Test Facility,
W89-00389 2C

FROUDE NUMBER
Extreme Pressures in Hydraulic-Jump Stilling Basins,
W89-00896 8B

FROZEN GROUND
Subsoil Investigation of Ice Lensing at the Calgary, Canada, Frost Heave Test Facility,
W89-00389 2C

FUEL
Other Forms of Environmental Pollution,
W89-00794 5B

FULVIC ACIDS
Formation of Oxygen Species and Their Reactions with Organic Chemicals in Aqueous Solution,
W89-00575 5B

Copper Binding by Dissolved Organic Matter: I. Suwannee River Fulvic Acid Equilibria,
W89-01077 5B

Copper Binding by Dissolved Organic Matter: II. Variation in Type and Source of Organic Matter,
W89-01078 5B

FUNGICIDES
Acute and Chronic Toxicity of Triphenyltin Hydroxide to Fathead Minnows (Pimephales promelas) Following Brief or Continuous Exposure,
W89-01057 5C

Determination of Thiram in Water and Soils by Cathodic Stripping Voltammetry Based on Adsorptive Accumulation,
W89-01087 5A

FUTURE PLANNING
Planning Indiana's Water Infrastructure from a Competitive Perspective,
W89-00880 6B

Assessing the Influence of Environmental Parameters on the Hydrological Cycle,
W89-00916 2A

GAMMA RADIATION
Improved Methodology for a Collinear Dual-Energy Gamma Radiation System,
W89-00985 7B

GANGES RIVER
Heavy-Metal Toxicity in the Cyanobacterium Nostoc linckia,
W89-00094 5C

GARBAGE DUMPS
Estimation of the Risk Associated with the Organic Constituents of Hazardous and Municipal Waste Landfill Leachates,
W89-00995 5B

GAS CHROMATOGRAPHY
Analysis of ppb Levels of Organics in Water by Means of Purge-and-Trap, Capillary Gas Chromatography and Selective Detectors,
W89-00288 5A

Simultaneous Gas Chromatographic Determination of Nitrobenzene and 2,4-Dinitrophenol in Nitrobenzene Manufacturing Plant Wastewater,
W89-00479 5A

GAS CHROMATOGRAPHY

Use of Total Organic Carbon as an Indicator of Contamination from an Oil Refinery, South-Central Kansas,
W89-00942 5A

Gas Chromatographic-Mass Spectrometric Investigations on Lipophilic Anthropogenic Substances in Environmental Samples. II: A Splitter for the Simultaneous Detection of Capillary Gas Chromatograms by up to Four Different GC-Detectors,
W89-01086 5A

Comparing Headspace with Purge and Trap for Analysis of Volatile Priority Pollutants,
W89-01119 5A

GASOLINE

Trends in Lead Concentrations in Major U.S. Rivers and Their Relation to Historical Changes in Gasoline-Lead Consumption,
W89-00868 5B

GASTROPODS

Ecology of Freshwater Gastropods in the Central Canadian Region,
W89-01183 2H

GATES

Improvement of the Electrical Equipment and Control Systems to the Lock Mechanisms of the Moscow Canal,
W89-00052 8C

GDANSK BAY

Influence of the Vistula River on Distribution of 226Ra in the Gdansk Bay,
W89-00250 2K

Contemporary Changes in Coastal Biocenoses of the Gdansk Bay (South Baltic), A Review,
W89-00254 2L

GENETIC POLLUTANTS

Conjugal Transfer of R68.45 and FP5 between Pseudomonas aeruginosa Strains in a Freshwater Environment,
W89-00728 5B

GENEVA

Contamination of Surface Sediments of the Principal Rivers of Geneva Canton by Polychlorinated Biphenyls and DDT (Contamination des Sediments Superficiels des Principales Rivieres du Canton de Geneve par les Polychlorobiphenyles et DDT),
W89-00690 5B

GEOCHEMISTRY

Soil Processes and Sulfate Loss at the Hubbard Brook Experimental Forest,
W89-00206 5B

Effects of Acidification on Metal Budgets of Lakes and Catchments,
W89-00207 5C

Influence of the Vistula River on Distribution of 226Ra in the Gdansk Bay,
W89-00250 2K

Determination of Hydrophilic Thiols in Sediment Porewater Using Ion-Pair Liquid Chromatography Coupled to Electrochemical Detection,
W89-00266 7B

Physicochemical and Geotechnical Characteristics of Recent Saguenay Fjord Sediments,
W89-00390 2J

Boron Levels in Some Ground Waters of Halkidiki (A Land at Northern Aegean Sea),
W89-00569 5B

Biogeochemistry of Benz(a)anthracene at the Sediment-Water Interface,
W89-00612 5B

Ca(+2)-Stress, Biological Response and Particle Aggregation in the Aquatic Habitat,
W89-00669 2K

Multisignal Automatic Calibration Methodology for Hydrochemical Models: A Case Study of the Birkenes Model,
W89-00973 5B

Trace Metal Geochemistry of Pore Water Brines from Two Hypersaline Lakes,
W89-01079 2K

Use of Hydrogeochemical Sampling Data in Hydraulic Engineering,
W89-01178 2F

Role of Soil Organic Matter in the Geochemical Cycling of Chloride and Bromide,
W89-01200 2A

Relationship Between Glacial Geology and Streamwater Chemistry in an Area Receiving Acid Deposition,
W89-01210 5B

Chemical Evolution of a Travertine-Depositing Stream: Geochemical Processes and Mass Transfer Reactions,
W89-01250 2K

GEOGRAPHY

Satellite Data and Geographical Information System for Land Use Classification,
W89-00756 7B

Geography of the Estuary and Firth of Clyde,
W89-00798 2L

GEOHYDROLGOY

Simulation of Regional Ground Water Flow in Bedrock, Southwestern New York-Northwestern Pennsylvania,
W89-00882 2F

GEOHYDROLOGY

Esker Aquifers,
W89-00264 4B

Regional Hydrogeology of Agricultural Drainage Wells in Iowa,
W89-00471 5B

Hydrogeological and Hydrogeochemical studies of the Unsaturated Flow in a Gravel Aquifer: Part II. Results of Long Term Soil-hydrological Measurements (Hydrogeologische und Hydrochemische Untersuchungen in der Ungesaettigten Zone eines Kiesgrundwasserleiters: Teil II. Ergebnisse Langjaehriger Bodenhydrologischer Messungen),
W89-00503 2F

Groundwater Flow Systems in Mountainous Terrain: 2. Controlling Factors,
W89-00709 2F

Evaluating Peat-Mining Hydrology Using DRAINMOD,
W89-00755 4C

Geological and Geomorphological Setting of the Estuary and Firth of Clyde,
W89-00799 2L

Dry Stream Reaches in Carbonate Terranes: Surface Indicators of Ground-Water Reservoirs,
W89-00870 7B

Contaminant Hydrogeology Dollars and Sense,
W89-01028 5B

Aragonite-to-Calcite Transformation During Fresh-Water Diagenesis of Carbonates: Insights from Pore-Water Chemistry,
W89-01076 2K

Use of Hydrogeochemical Sampling Data in Hydraulic Engineering,
W89-01178 2F

Hydrogeology of Two Saskatchewan Tills. I. Fractures, Bulk Permeability, and Spatial Variability of Downward Flow,
W89-01201 2F

Hydrogeology of Two Saskatchewan Tills. II. Occurrence of Sulfate and Implications for Soil Salinity,
W89-01202 2F

Modeling of Tracer Spreading in a Fracture in which the Aperture Decreases with Depth in a Laminar Flow (Modelisation de la Propagation d'un Traceur dans une Fracture qui se Ferme Progressivement en Profondeur dans l'Hypothese d'un Ecoulement Laminaire Parallele),
W89-01214 2F

GEOLOGIC FRACTURES

Continuum Approach for Modeling Mass Transport in Fractured Media,
W89-00980 5B

GEOLOGIC HISTORY

Geological and Geomorphological Setting of the Estuary and Firth of Clyde,
W89-00799 2L

Changes in the Ecosystem of the Azov Sea in Relation to Economic Development in the Basin,
W89-01192 6G

GEOLOGY

Coastal Topography of the Moray Firth,
W89-00775 2L

GEOMORPHOLOGY

Development of Streamlined Bog Islands in the Continental Interior of North America,
W89-00434 2H

Dynamic Changes and Processes in the Mississippi River Delta,
W89-00469 2J

Geomorphology, Offshore Bathymetry and Quaternary Lithostratigraphy around the Bot River Estuary,
W89-00649 2L

Barrier/Estuarine Processes. Bot River Estuary: An Interpretation of Aerial Photographs,
W89-00650 2L

Historical Records of the Bot River Estuarine System,
W89-00653 2L

Synopsis of the Impact of Artificially Opening the Mouth of the Bot River Estuary: Implications for Management,
W89-00666 2L

Tidal Asymmetry and Estuarine Morphology,
W89-00670 2L

Estimation of the Time Scale of the Geomorphologic Instantaneous Unit Hydrograph from Effective Streamflow Velocity,
W89-00704 2E

Geological and Geomorphological Setting of the Estuary and Firth of Clyde,
W89-00799 2L

Fractal Nature of River Networks,
W89-00975 2E

Hydrological Heterogeneity Catchment Morphology and Catchment Response,
W89-01024 2A

GEOPHYSICS
Multiple Reflection and Attenuation of Time Domain Reflectometry Pulses: Theoretical Considerations of Applications to Soil and Water,
W89-00701 7B

Determination of Electrical Conductivity Using Time Domain Reflectometry: Soil and Water Experiments in Coaxial Lines,
W89-00702 2G

GEOTHERMAL STUDIES
Mercury in Freshwater Fish and Clams from the Cerro Prieto Geothermal Field of Baja California, Mexico,
W89-01153 5B

GERMANY
Structure of Macrobenthic Biomass in the Gravel Bed of the Pre-Alpine Loisach River (Die Struktur der makrobenthischen Biomasse in einem voralpinen Schotterbett am Beispiel der mittleren Loisach),
W89-00167 2H

Chlorinated Hydrocarbons in Sediments of the Elbe River and the Elbe Estuary,
W89-00614 5B

GERMINATION
Seed Germination Traits of Annuals and Emergents Recruited during Drawdowns in the Delta Marsh, Manitoba, Canada,
W89-00126 2H

GILLS
Micronucleus Test: Examples of Application to Marine Ecology,
W89-01042 5A

GLACIAL AQUIFERS
Esker Aquifers,
W89-00264 4B

Hydrogeology of Two Saskatchewan Tills. I. Fractures, Bulk Permeability, and Spatial Variability of Downward Flow,
W89-01201 2F

Hydrogeology of Two Saskatchewan Tills. II. Occurrence of Sulfate and Implications for Soil Salinity,
W89-01202 2F

GLACIAL DRIFT
Relationship Between Glacial Geology and Streamwater Chemistry in an Area Receiving Acid Deposition,
W89-01210 5B

GLACIAL TILL
Hydrogeology of Two Saskatchewan Tills. I. Fractures, Bulk Permeability, and Spatial Variability of Downward Flow,
W89-01201 2F

Hydrogeology of Two Saskatchewan Tills. II. Occurrence of Sulfate and Implications for Soil Salinity,
W89-01202 2F

GLACIATION
Coastal Topography of the Moray Firth,
W89-00775 2L

GLACIOLOGY
Creep of Ice Measured with the Pressuremeter,
W89-00387 2C

GLOVER RIVER
Habitat Use of Two Darter Species in Glover River, Oklahoma,
W89-00396 2H

GLYCOLATE
Photoexcretion and Fate of Glycolate in a Hot Spring Cyanobacterial Mat,
W89-00342 2H

GODAVARI RIVER
Sediment Transport of the Godavari River Basin and Its Controlling Factors,
W89-01211 2J

GOVERNMENTAL INTERRELATIONS
Sea Use Planning in Norwegian Waters: National and International Dimensions,
W89-00289 6E

GRAPHICAL METHODS
Drainage Basin Peak Discharge Rating Curve,
W89-00913 2E

GRAPHICAL MODELS
Modern Management Standards of Water Network Register (Criteres Modernes de Gestion du Cadastre des Reseaux d'Eau),
W89-00919 5F

GRASSES
Spartina alterniflora Die-Back in Louisiana: Time-Course Investigation of Soil Waterlogging Effects,
W89-00286 2H

GRAVIMETRIC ANALYSIS
Gravimetric Measurement of Adsorption Parameters in Water Systems with a Quartz Spring Balance,
W89-01216 5A

GRAVITY DAMS
Complex Geology Leads to an Unusual Design for the Lakhwar Dam,
W89-01005 8E

GRAVITY FLOW
Air and Water Flow: II. Gravitational Flow with an Arbitrary Flux Boundary Condition,
W89-00348 2G

GRAZING
Bacterial Water Quality Responses to Four Grazing Strategies: Comparisons with Oregon Standards,
W89-01170 5B

GREAT LAKES
Great Lakes Shore Erosion,
W89-00133 4D

GREBES
Spatial and Temporal Distribution Patterns of Three Trophic Levels in a Saline Lake,
W89-00219 2H

GREECE
Ecological Parameter of Surface Water in Northeastern Greece,
W89-00564 5B

Correlation of Some Organic Pollution Factors in Water Systems in Northern Greece,
W89-00566 5B

Comparative Study of Heavy Metals Pollution in Various Rivers and Lakes of Northern Greece,
W89-00571 5B

Wet-Only Precipitation Study in a Mediterranean Site, Patras, Greece,
W89-01152 2B

GREEN-AMPT EQUATION
Explicit Solution to Green-Ampt Equation for Nonuniform Soils,
W89-00760 7B

GREEN BAY
Effects of Light and Temperature on Photosynthesis of the Nuisance Alga Cladophora glomerata (L.) Kutz from Green Bay, Lake Michigan,
W89-00848 2H

GREENHOUSE EFFECT
Repercussions of a CO2 Doubling on the Water Cycle and on the Water Balance - A Case Study for Belgium,
W89-00355 2A

Other Forms of Environmental Pollution,
W89-00794 5B

GREIFENSEE
Drift of Zooplankton in a Lake-Outlet (Glatt) in a Day-Night-Rhythm Depending from the Water Level,
W89-00025 2H

GROUNDWATER
Prediction of Rainbow Trout Embryo Survival in Relation to Groundwater Seepage and Particle Size of Spawning Substrates,
W89-00326 2H

Effect of Permanganate Oxidation and Chlorination on the Mutagenic Activity and other Quality Parameters of Artificially Recharged Ground Water Processed from Humus-rich Surface Water,
W89-00599 5F

Iron Oxide Formation in Artificial Ground Waters,
W89-00687 2F

Chemistry and Delta 13C of Total Dissolved Carbon in Waters of Selected Springs Nearby Lublin City: Weekly Observations from October 1982 to June 1983,
W89-00895 2F

Definition of a Model for Monitoring the Chemical and Chemical-Physical Characteristics of Deep Drinking Waters,
W89-00927 7C

There's No Such Thing as a Representative Ground Water Sample,
W89-00937 5A

Making the Most of Field-Measurable Ground Water Quality Parameters,
W89-00939 7B

Oxygen Transfer Through Flexible Tubing and Its Effects on Ground Water Sampling Results,
W89-00943 5A

Discrete Point Sampler for Ground Water Monitoring Wells,
W89-00947 7B

Nonaqueous Phase Liquid Transport and Cleanup: II. Experimental Studies,
W89-00969 5B

Aerobic Biodegradation of Natural and Xenobiotic Organic Compounds By Subsurface Microbial Communities,
W89-01090 5B

MODALP: A Deterministic Rainfall-Runoff Model for Large Karstic Areas,
W89-01145 2F

General Correction for Spontaneous Potential Well Logs in Fresh Water,
W89-01195 7B

GROUNDWATER LEVEL
Effect of Logging and Regeneration on Groundwater, Streamflow and Stream Salinity in the Southern Forest of Western Australia,
W89-00350 4C

GROUNDWATER MANAGEMENT
Development and Management of Groundwater Resources on Diego Garcia,
W89-00423 4B

GROUNDWATER MANAGEMENT

Remote Sensing Applications in Water Resource Prospecting and Management,
W89-00459 7B

Groundwater Rights: Definition and Transfer,
W89-00838 6E

Water Catchment Installations Harmonized with Ecological Aspects - An Example in Berlin (West),
W89-00926 6B

River Regulation by Seasonal Groundwater Abstraction: The Case of the River Itchen,
W89-00956 4B

Management of a Tributary Aquifer,
W89-00978 4B

New Directions in Nebraska Water Policy,
W89-01266 6E

State Equitable Apportionment of Western Water Resources,
W89-01267 6E

Recurring State Judicial Task of Choosing Rules for Groundwater Law: How Occult Still,
W89-01268 6E

GROUNDWATER MINING

Historical Use of Ground Water in Terrell, Texas,
W89-00461 4B

GROUNDWATER MOVEMENT

Esker Aquifers,
W89-00264 4B

Modelling of Flow Through Potash Tailings Piles,
W89-00388 5B

Hydrogeological and Hydrogeochemical studies of the Unsaturated Flow in a Gravel Aquifer: Part II. Results of Long Term Soil-hydrological Measurements (Hydrogeologische und Hydrochemische Untersuchungen in der Ungesaettigten Zone eines Kiesgrundwasserleiters: Teil II. Ergebnisse Langjaehriger Bodenhydrologischer Messungen),
W89-00503 2F

Dispersion in Heterogeneous Porous Media: 1. Local Volume Averaging and Large-Scale Averaging,
W89-00699 5B

Dispersion in Heterogeneous Porous Media: 2. Predictions for Stratified and Two-Dimensional Spatially Periodic Systems,
W89-00700 5B

Single-Well Tracing Method for Estimating Regional Advective Velocity in a Confined Aquifer: Theory and Preliminary Laboratory Verification,
W89-00707 2F

Groundwater Flow Systems in Mountainous Terrain: 1. Numerical Modeling Technique,
W89-00708 2F

Groundwater Flow Systems in Mountainous Terrain: 2. Controlling Factors,
W89-00709 2F

Distributed Parameter Approach for Evaluating the Accuracy of Groundwater Model Predictions: 1. Theory,
W89-00711 2F

Distributed Parameter Approach for Evaluating the Accuracy of Groundwater Model Predictions: 2. Application to Groundwater Flow,
W89-00712 2F

Three-Dimensional Radial Dispersion in a Variable Velocity Flow Field,
W89-00715 5B

Microscale Haline Convection - A Proposed Mechanism for Transport and Mixing at the Water Table Region,
W89-00718 2F

Simulation of Regional Ground Water Flow in Bedrock, Southwestern New York-Northwestern Pennsylvania,
W89-00882 2F

Groundwater Velocity Magnitude in Radionuclide Transport Calculations,
W89-00903 5B

Tracer Test Analysis of Anisotropy in Hydraulic Conductivity of Granular Aquifers,
W89-00940 2F

Continuum Models for Contaminant Transport in Fractured Porous Formations,
W89-00966 5B

Comparison of Two Methods for Summarizing Hydraulic Conductivities of a Layered Soil,
W89-00970 2G

Continuum Approach for Modeling Mass Transport in Fractured Media,
W89-00980 5B

Contaminant Transport in Fractured Porous Media: Steady State Solutions by a Boundary Integral Method,
W89-00982 5B

Drawdown Interval Analysis: A Method of Determining the Parameters of Shallow Conduit Flow Carbonate Aquifers from Pumping Tests,
W89-00986 2F

Theoretical Analysis of Deviations from Local Equilibrium During Sorbing Solute Transport Through Idealized Stratified Aquifers,
W89-00987 5B

Sorption Nonequilibrium During Solute Transport,
W89-00988 5B

Status of Isotope Hydrology Today,
W89-01018 2A

Groundwater Flow and Transport Modeling,
W89-01025 2F

Coping with Groundwater Contamination,
W89-01135 5G

Pumping Tests in Nonuniform Aquifers: The Radially Symmetric Case,
W89-01196 2F

Stable Isotope Study of Recharge Processes in the English Chalk,
W89-01197 2F

Modeling of Tracer Spreading in a Fracture in which the Aperture Decreases with Depth in a Laminar Flow (Modelisation de la Propagation d'un Traceur dans une Fracture qui se Ferme Progressivement en Profondeur dans l'Hypothese d'un Ecoulement Laminaire Parallele),
W89-01214 2F

New Approximate Technique for the Hodograph Method in Groundwater Flow and Its Application to Coastal Aquifers,
W89-01243 2F

Time-Dependent Macrodispersion for Solute Transport in Anisotropic Heterogeneous Aquifers,
W89-01245 2F

GROUNDWATER ORIGINS

Use of Hydrogeochemical Sampling Data in Hydraulic Engineering,
W89-01178 2F

GROUNDWATER POLLUTION

Systems Approach to Nitrate Removal from Groundwater Supplies,
W89-00134 5F

Geostatistics Applied to Groundwater Pollution: III. Global Estimates,
W89-00493 5B

Innovative Septic System Management,
W89-00508 5D

Transient Liver Pathology in Patients Consuming Water from a Private Well Contaminated by PCBs from a Submersible Water Pump,
W89-00558 5C

Boron Levels in Some Ground Waters of Halkidiki (A Land at Northern Aegean Sea),
W89-00569 5B

Analysis of Atrazine in Underground Waters at Part Per Trillion Levels as an Early Warning Method for Contamination and for Soil Distribution Studies,
W89-00596 5A

Iron Oxide Formation in Artificial Ground Waters,
W89-00687 2F

Microbial Pollution of Well Water in Southeastern Minnesota,
W89-00887 5B

Basic Encoded Model for One-Dimensional Ground Water Systems Incorporating First-Order Degradation Kinetics,
W89-00888 5B

Acidification of Shallow Groundwaters During the Spring Melt Period,
W89-00893 5B

Groundwater Velocity Magnitude in Radionuclide Transport Calculations,
W89-00903 5B

Reliability of Chemical Analyses of Water Samples: The Experience of the UMTRA Project,
W89-00941 5A

Use of Total Organic Carbon as an Indicator of Contamination from an Oil Refinery, South-Central Kansas,
W89-00942 5A

Sensitivity of Four Monitoring Well Sampling Systems to Low Concentration of Three Volatile Organics,
W89-00944 5A

Screened Auger Sampling: The Technique and Two Case Studies,
W89-00945 5A

Contamination of Farmstead Wells by Pesticides, Volatile Organics, and Inorganic Chemicals in Kansas,
W89-00946 5B

Discrete Point Sampler for Ground Water Monitoring Wells,
W89-00947 7B

Encapsulated Herbicides Could Curb Ground Water Pollution,
W89-00964 5G

Problem with Nitrates,
W89-00965 5B

Nonaqueous Phase Liquid Transport and Cleanup: I. Analysis of Mechanisms,
W89-00968 5B

Nonaqueous Phase Liquid Transport and Cleanup: II. Experimental Studies,
W89-00969 5B

Method for Locating Wells in a Groundwater Monitoring Network Under Conditions of Uncertainty,
W89-00971 7A

Analytical Solution for Aquifer Decontamination by Pumping,
W89-00977 5G

Reactor Accident at Chernobyl: A Possibility to Test Colloid-Controlled Transport of Radionuclides in a Shallow Aquifer,
W89-00990 5B

Statistical Correlations for Predicting the Partition Coefficient for Nonpolar Organic Contaminants Between Aquifer Organic Carbon and Water,
W89-00992 5B

Estimation of the Risk Associated with the Organic Constituents of Hazardous and Municipal Waste Landfill Leachates,
W89-00995 5B

Interaction of Earthen Liner Materials with Industrial Waste Leachate,
W89-00997 5E

Transport of Solutes in Soils and Aquifers,
W89-01027 5B

Contaminant Hydrogeology Dollars and Sense,
W89-01028 5B

Radionuclides in Drinking Water,
W89-01104 5B

Occurrence of Radon in Well Supplies,
W89-01105 5B

Occurrence of Radon, Radium, and Uranium in Groundwater,
W89-01108 5B

Coping with Groundwater Contamination,
W89-01135 5G

Septic System Performance on a Coastal Barrier Island,
W89-01163 5D

Transport Modelling of Biological Tracers from Septic Systems,
W89-01226 5B

Numerical Transport Model for Oxygen- and Nitrate-Based Respiration Linked to Substrate and Nutrient Availability in Porous Media,
W89-01251 5D

GROUNDWATER RECHARGE

Esker Aquifers,
W89-00264 4B

Validity of the Environmental Chloride Method for Recharge Evaluation of Coastal Aquifers, India.
W89-00356 7B

Acidification of Shallow Groundwaters During the Spring Melt Period,
W89-00893 5B

Groundwater Recharge in Arid Regions: Review and Critique of Estimation Methods,
W89-00914 2F

Fog Drip as a Source of Groundwater Recharge in Northern Kenya,
W89-00984 2F

Stable Isotope Study of Recharge Processes in the English Chalk,
W89-01197 2F

In-Situ Method for Monitoring Layered Hydraulic Impedance Development During Artificial Recharge with Turbid Water,
W89-01205 2F

Modeling of Tracer Spreading in a Fracture in which the Aperture Decreases with Depth in a Laminar Flow (Modelisation de la Propagation d'un Traceur dans une Fracture qui se Ferme Progressivement en Profondeur dans l'Hypothese d'un Ecoulement Laminaire Parallele),
W89-01214 2F

GROUNDWATER RESERVOIR

Dry Stream Reaches in Carbonate Terranes: Surface Indicators of Ground-Water Reservoirs,
W89-00870 7B

GROUNDWATER TABLE

Stokes Surfaces and the Effects of Near-Surface Groundwater-Table on Aeolian Deposition,
W89-00410 2J

GROUTING

Characteristics of the Organization and Performance of Works in the Dam Foundation of the Al-Hadithah Hydro Development (Iraq),
W89-01182 8F

GROWTH

Growth and Conversion Efficiency of the Catfish Heteropneustes fossilis (Bloch) Exposed to Sub-Lethal Concentrations of Sodium Pentachlorophenate,
W89-00243 5C

Fecundity Dynamics of Khramulya, Varicorhinus capoeta sevangi, in Relation to the Changing Environment of Lake Sevan,
W89-01194 2H

Effect of Environmental Conditions on the Occurrence of Microthrix parvicella in Activated Sludge,
W89-01217 5D

GROWTH KINETICS

Growth Kinetics of Hydroxide Flocs,
W89-00428 5F

GROWTH RATE

Effect of Light Regime upon Growth Rate and Chemical Composition of a Clone of Skeletonema costatum from the Trondheimsfjord, Norway,
W89-00212 2L

GROWTH RATES

Effect of pH and Total Ion Concentration on Growth Rate of Chironomus nr. maturus Larvae (Diptera: Chironomidae) from an Acid Strip-Mine Lake,
W89-00399 5C

GUINEA WORM DISEASE

Guinea Worm Disease in Northern Uganda: A Major Public Health Problem Controllable Through an Effective Water Programme,
W89-00278 5F

GULF OF ISKENDERUN

Long Term Impact of Dissolved Dispersed Petroleum Hydrocarbons (DDPH) in Gulf of Iskenderun,
W89-00567 5B

Two Toxicants, Mercury and Tin in the Gulf of Iskenderun,
W89-00570 5B

GULF OF TRIESTE

Bacteriological Contamination of the Eastern Part of the Gulf of Trieste (North Adriatic) Due to Sewage Discharge,
W89-00577 5B

GYPSUM

Effect of Sodium Nitrate and Gypsum on Infiltration and Erosion of a Highly Weathered Soil,
W89-00409 2G

HABITATS

Habitat Suitability and Fish Production: A Model Evaluation for Rock Bass in Two Virginia Streams,
W89-00294 2H

Microhabitat Use by an Assemblage of California Stream Fishes: Developing Criteria for Instream Flow Determinations,
W89-00319 6D

Relations Between Habitat Variables and Channel Catfish Populations in Prairie Streams,
W89-00325 2H

HALIDES

Biosorption of Organic Halide in a Kraft Mill Generated Lagoon,
W89-01138 5D

HALOPHYTES

Peat Accumulation and the Success of Marsh Plants,
W89-00909 2H

HANJIANG ESTUARY

Chemical Behavior of Metal Elements in the Sediments in the Hanjiang River Estuary and Shantou Port, (in Chinese),
W89-00202 2L

HARBORS

Analysis of the Effects of Suspended Sediment of Huanghe River on Harbor Construction by Using NOAA Images, (in Chinese),
W89-00536 2J

HATCHING

Effects of Cadmium on Early Developmental Stages of the Sheepshead Minnow (Cyprinodon Variegatus),
W89-01091 5C

HAWAII

Distribution of Arsenic in the Sediments and Biota of Hilo Bay, Hawaii,
W89-00677 5B

Possible Mechanism for Manganese Phytotoxicity in Hawaii Soils Amended with a Low-Manganese Sewage Sludge,
W89-01169 5E

HAZARDOUS MATERIALS

Immobilization of Leachable Toxic Soil Pollutants by Using Oxidative Enzymes,
W89-00341 5G

Hazardous and Noxious Substances,
W89-00519 5G

Estimation of the Risk Associated with the Organic Constituents of Hazardous and Municipal Waste Landfill Leachates,
W89-00995 5B

Design Criteria for In-Situ and On-Site Renovation of an Industrial Sludge Lagoon,
W89-00996 5B

Leaching of Inorganic Hazardous Constituents from Stabilized/Solidified Hazardous Wastes,
W89-00999 5E

Transmission Electron Microscopic Study of Solidified/Stabilized Organics,
W89-01000 5E

HAZARDOUS WASTE DISPOSAL
Sensitivity of Four Monitoring Well Sampling Systems to Low Concentration of Three Volatile Organics,
W89-00944 5A

HAZARDOUS WASTES
Creosote Compounds in Snails Obtained from Pensacola Bay, Florida, near an Onshore Hazardous-Waste Site,
W89-00611 5B

HAZARDS
Gas Shows during Construction of Hydraulic Tunnels,
W89-00071 8E

HEAD-SPACE ANALYSIS
Head-Space Analysis of Readily Volatile Chlorinated Hydrocarbons in Air and Water (Head-Space-Analytik Leichtfluechtiger Chlorkohlenwasserstoffe in Luft und Wasser),
W89-00504 5A

HEAT BALANCE
Heat Balance of a Tidal Flat Area,
W89-00148 2L

HEATED WATER
Effect of a Heated Wastewater Discharge upon River Protozoan Species Pool Variability through Time and Space,
W89-00077 5C

HEAVY METALS
Background Aspects of Lake Restoration: Water Balance, Heavy Metal Content, Phosphorus Homeostasis,
W89-00014 2H

Influence of Dusts from Chosen Industrial Plants on Particular Links of Forest Ecosystem of the Niepolomice Forest,
W89-00081 5C

Heavy-Metal Toxicity in the Cyanobacterium Nostoc linckia,
W89-00094 5C

Use of Mires in Monitoring the Atmospheric Deposition of Heavy Metals,
W89-00123 5A

Some Hydrochemical, Hydrobiological, and Ichthyological Features of Yugoslav Part of the Danube Lasting for Several Years (Einige hydrochemische, hydrobiologische und ichthyologische Eigenschaften der jugoslawischen Donaustrecke in mehrjahrigem Zeitraum),
W89-00165 5C

Limits of Growth of Five Chlorella Species in the Presence of Toxic Heavy Metals,
W89-00191 5C

Preliminary Study on the Migration and Transformation of Heavy Metals in the Sewage-Seawater Mixing Zone of Jinzhou Bay, (in Chinese),
W89-00199 5B

Instrumentation for 7-Day Continuous Cycle Monitoring of Metals with Automated On-Line Sample Preparation, High-Performance Liquid Chromatography, and Electrochemical Detection,
W89-00210 5A

Chemical Mechanisms of Heavy Metal Transport in Waters of Mala Panew and Brynica Rivers (Silesia, Poland),
W89-00251 5B

Effect of Drainage Basin on Heavy Metal Concentrations in Stream Waters in the Niepolomice Forest,
W89-00260 5B

Impact of Manganese Intoxication on the Blood Pyruvic Acid of a Freshwater Tropical Perch Colisa fasciatus,
W89-00263 5A

Simultaneous Removal of Heavy Metal Ions from Wastewater by Foam Separation Techniques,
W89-00265 5D

Determination of Heavy Metals at the Pg/g Level in Antarctic Snow with DPASV and IDMS,
W89-00270 5A

Acute Toxicities of Eleven Metals to Early Life-History Stages of the Yellow Crab Cancer anthonyi,
W89-00386 5C

Depressed Mercury Levels in Biota from Acid and Metal Stressed Lakes Near Sudbury, Ontario,
W89-00442 5B

Influence of Selected Organic Complexing Agents on the Sorption of Heavy Metals in River Sediments (Einfluss Ausgewaehlter Organischer Komplexbildner auf die Sorption von Schwermetallen an Gewaessersedimente),
W89-00501 5B

Effects of Six Heavy Metals on Hatching Eggs and Survival of Larva of Marine Fish, (in Chinese),
W89-00533 5C

Chromium Speciation in the Huanghe River and Its Estuarine Region, (in Chinese),
W89-00544 5B

Preconcentration of Heavy Metals in Natural Waters with Hydrazones Supported on Silica Gel,
W89-00568 5A

Two Toxicants, Mercury and Tin in the Gulf of Iskenderun,
W89-00570 5B

Comparative Study of Heavy Metals Pollution in Various Rivers and Lakes of Northern Greece,
W89-00571 5B

Heavy Metal Pollution in the Guadiamar River and the Guadalquivir Estuary (South West Spain),
W89-00573 5B

Survey of Mercury, Lead and Cadmium in Muscle of British Freshwater Fish,
W89-00587 5B

Contributions of Heavy Metals from Municipal Runoff to the Sediments of Lake Pontchartrain, Louisiana,
W89-00618 5B

Sequential Extraction of Phosphorus and Heavy Metals from Sediments: Methodological Considerations,
W89-00629 5A

Assessment of the Toxicity of Heavy Metals to the Anaerobic Digestion of Sewage Sludge,
W89-00631 5D

Heavy Metal Removal by Different Water Treatment Plants, in Rio de Janeiro State, Brazil,
W89-00647 5F

Interpretation of Metal Profiles in a Sediment Core from Lake Geneva: Metal Mobility or Pollution,
W89-00694 5B

Sediment Analysis: Lability of Selectively Extracted Fractions,
W89-00744 5A

Trace Metals in the Common Mussel Mytilus edulis (L.) in the Clyde Estuary,
W89-00823 5B

Toxicity of Sea-Surface Microlayer: Effects On Herring and Turbot Embryos,
W89-00855 5C

Recent Transport of Metals in the River Severn as Recorded by the Sediments of Chelmarsh Reservoir, Shropshire, U.K.,
W89-00885 5B

Microporous Filters with Oxidizing Power for Iron and Manganese Removal from Water,
W89-00889 5F

Use of Factorial Experimental Design to Evaluate How Biotic and Abiotic Factors Influence Cadmium Accumulation in the Unicellular Alga Dunaliella bioculata,
W89-01043 5B

Formation of Hydrous Zirconium (IV) Oxide Polyelectrolyte Membranes, I. Poly (itaconic acid) and Poly (acrylic-co-itaconic acid),
W89-01062 3A

Sensitivity of Freshwater Pulmonate Snails, Lymnaea luteola L., to Heavy Metals,
W89-01154 5C

Effects of Cyanide and Polyphosphates on Adsorption of Metals from Simulated and Real Mixed-Metal Plating Wastes,
W89-01219 5D

Binding of Heavy Metals to Algal Surfaces,
W89-01227 5B

Metallothionein-Like Heavy Metal Binding Protein Levels in Asiatic Clams Are Dependent on the Duration and Mode of Exposure to Cadmium,
W89-01228 5B

HEPATITIS-A VIRUS
Polyethylene Glycol Precipitation for Recovery of Pathogenic Viruses, Including Hepatitis A Virus and Human Rotavirus, from Oyster, Water, and Sediment Samples,
W89-00730 5A

HERBICIDES
Effect of Gibberellic Acid and 2,4-D on Water Hyacinths,
W89-00105 4A

Tisza Water, as Irrigation Water, Polluted with Various Compounds,
W89-00145 3C

Investigations of the Ecotoxicological Effect of an Herbicide in an Aquatic Model Ecosystem: II. Food Chain Significance and Pesticide Balance (Untersuchungen zur okotoxikologischen Wirkung eines Herbizids in einem aquatischen Modellokosystem: II. Nahrungskettenprobleme und Schadstoffbilanzierung),
W89-00175 5C

Bromothymol-Blue Test: A Simple Algal Bioassay and its Use for Herbicide Screening,
W89-00192 5A

Comparison of Laboratory and Field Observations of Fish Exposed to the Herbicides Molinate and Thiobencarb,
W89-00376 5C

Estimate of the Variability in Biotransformation Kinetics of Xenobiotics in Natural Waters by Aufwuchs Communities,
W89-00559 5B

Determination of Phenoxy Acid Herbicides in Water Samples,
W89-00576 5A

Analysis of Atrazine in Underground Waters at Part Per Trillion Levels as an Early Warning Method for Contamination and for Soil Distribution Studies,
W89-00596 5A

Treatment of Herbicides in Ground Water,
W89-00938 5F

Encapsulated Herbicides Could Curb Ground Water Pollution,
W89-00964 5G

HERRING

Biology and Management of Herring and Other Pelagic Fish Stocks in the Firth of Clyde,
W89-00825 2L

Toxicity of Sea-Surface Microlayer: Effects On Herring and Turbot Embryos,
W89-00855 5C

HETEROGENEITY

Hydrological Heterogeneity Catchment Morphology and Catchment Response,
W89-01024 2A

HETEROTROPHIC BACTERIA

Microbiological Examination of the Carska Bara Swamp Water,
W89-00146 2H

Development of Mass Blooms of Photosynthetic Bacteria on Sheltered Beaches in Scapa Flow, Orkney Islands,
W89-00795 2L

HIGH PERFORMANCE LIQUID CHROMATOGRAPHY

Instrumentation for 7-Day Continuous Cycle Monitoring of Metals with Automated On-Line Sample Preparation, High-Performance Liquid Chromatography, and Electrochemical Detection,
W89-00210 5A

HIGH PRESSURE GATES

Manufacture of Polyethylene Seals for High-head Gates of Hydraulic Structures,
W89-00043 8G

HILO BAY

Distribution of Arsenic in the Sediments and Biota of Hilo Bay, Hawaii,
W89-00677 5B

HISTORY

50th Anniversary of the Moscow Canal,
W89-00049 8A

Inhabitants' Life in the Lowland of the Kiso, Nagara and Ibi Rivers, (in Japanese),
W89-00205 4A

Texas Drought History Reconstructed and Analyzed from 1698 to 1980,
W89-00273 2B

Historical Use of Ground Water in Terrell, Texas,
W89-00461 4B

Historical Records of the Bot River Estuarine System,
W89-00653 2L

Geography of the Estuary and Firth of Clyde,
W89-00798 2L

Sewage Purification in South Africa - Past and Present,
W89-00933 5D

Regulated Rivers in the United Kingdom,
W89-00948 4A

River Regulation in the United Kingdom: An Historical Perspective,
W89-00949 4A

HOAR FROST

Determination of Nitrate at the Ng/g Level in Antarctic Snow Samples with Ion Chromatography and Isotope Dilution Mass Spectrometry,
W89-00269 5A

HODOGRAPH METHOD

New Approximate Technique for the Hodograph Method in Groundwater Flow and Its Application to Coastal Aquifers,
W89-01243 2F

HONGSHI RIVER

Intensive Hydro Development of the Hongshui River,
W89-01002 8C

HOT SPRINGS

Photoexcretion and Fate of Glycolate in a Hot Spring Cyanobacterial Mat,
W89-00342 2H

HUDSON BAY

Community Structure of Zooplankton in Eastern Hudson Bay,
W89-01232 2L

HUDSON RIVER

PCB-resistant Diatoms in the Hudson River Estuary,
W89-00284 5C

Sedimentation of 74 PCB Congeners in the Upper Hudson River,
W89-00584 5B

Age to PCB Concentration Relationship with the Striped Bass (Morone saxatilis) in the Hudson River and Long Island Sound,
W89-00597 5B

HUMAN DISEASES

Trace Element Content in Drinking Water of Nasopharyngeal Carcinoma Patients,
W89-00048 5C

Guinea Worm Disease in Northern Uganda: A Major Public Health Problem Controllable Through an Effective Water Programme,
W89-00278 5F

HUMIC ACIDS

Effect of Mangrove Humic-Like Substances on Biodegradation Rate of Detritus,
W89-00476 2L

Studies on Marine Humic Substances: III. The Distribution of Humic Substances in Seawater and Sediments in the Estuary of Changjiang River and East China Sea, (in Chinese),
W89-00541 2L

Studies on Marine Humic Substances: IV. The Distribution of Humic Substances in the Seawater and Sediments of Huanghe River Estuary, (in Chinese),
W89-00545 2L

Formation of Oxygen Species and Their Reactions with Organic Chemicals in Aqueous Solution,
W89-00575 5B

Effect of Permanganate Oxidation and Chlorination on the Mutagenic Activity and other Quality Parameters of Artificially Recharged Ground Water Processed from Humus-rich Surface Water,
W89-00599 5F

Effects of Aquatic Humic Substances on Analysis for Hydrogen Peroxide Using Peroxidase-Catalyzed Oxidations of Triarylmethanes or p-Hydroxyphenylacetic Acid,
W89-00634 7B

HUMIDITY

Patterns of Temperature and Humidity in Wetland Biotopes,
W89-00124 2H

Theoretical Evaluation of Water Oligomer Populations in the Earth's Atmosphere,
W89-00763 2B

HUNGARY

Water Quality of the Tisza River and the Alpar Backwater,
W89-00143 5B

Seasonal Composition, Biomass and Primary Productivity of the Phytoplankton in Lakitelek Backwater during 1980 and 1983,
W89-00144 2H

Tisza Water, as Irrigation Water, Polluted with Various Compounds,
W89-00145 3C

Seasonal Changes of Phytoplankton in the Backwater Bokros,
W89-00147 2H

Role of Storms in the Summer Succession of the Phytoplankton Community in a Shallow Lake (Lake Balaton, Hungary),
W89-00232 2H

HURRICANES

Hurricane-Related Morphodynamics and Implications for Hazard Mitigation, Perdido Key, Florida, U.S.A.,
W89-00291 6B

HYDRA

Dynamics of Hydra Populations in Lake Zurich, Switzerland, and Lake Maggiore, Italy,
W89-00692 2H

HYDRAULIC CONDUCTIVITY

Effect of Assumed Unit Gradient During Drainage on the Determination of Unsaturated Hydraulic Conductivity and Infiltration Parameters,
W89-00407 2G

Water Flow in Layered Soils with Sloping Surface,
W89-00752 2G

Finite Element Computation of Shape Factors for Kirkham's Piezometer Tube Method for Hydraulic Conductivity of Saturated Soil,
W89-00911 2G

Tracer Test Analysis of Anisotropy in Hydraulic Conductivity of Granular Aquifers,
W89-00940 2F

Comparison of Two Methods for Summarizing Hydraulic Conductivities of a Layered Soil,
W89-00970 2G

Interaction of Earthen Liner Materials with Industrial Waste Leachate,
W89-00997 5E

Sensitivity Analysis of Closed-Form Analytical Hydraulic Conductivity Models,
W89-01204 2G

HYDRAULIC DESIGN
50th Anniversary of the Moscow Canal,
W89-00049 8A

Small Hydroelectric Stations and Prospects of Their Development,
W89-00059 8C

Improvement of the Effectiveness of Spillway Operation of High-Head Hydroelectric Stations,
W89-00067 8B

HYDRAULIC ENGINEERING
Hydraulic Tests for Reconstructing the Pumping Stations on the Moscow Canal,
W89-00055 8C

Components of Forces of a Reservoir Acting on the Foundation of High Dams,
W89-00073 8B

Certain Characteristics of Calculating Angular Retaining Walls,
W89-00076 8A

Reconstruction of the Surge Tank of the Sengilei Hydroelectric Station,
W89-00546 8C

Calculation of Pressure Tunnel Linings with Consideration of Consolidation Grouting of the Rocks,
W89-00547 8C

Determination of the Mechanical Characteristics of Rocks by the Method of Volume Confinement of Deformations,
W89-00548 8E

Use of Clay Soils in the Construction of Cutoff Curtains,
W89-00549 8D

Modification of Turbine Runner Blades at the Chirkey Hydroelectric Station,
W89-00555 8C

New Pumped-Storage Station Designs,
W89-00556 8C

Estimation of the Reliability of Earth Dams with Consideration of Seismic Loads,
W89-00557 8E

Horizontal Round Buoyant Jet in Shallow Water,
W89-00902 5E

HYDRAULIC EQUIPMENT
Adjusting and Modernization of the System Converting Units to Synchronous Capacitor Operation at the Sayano-Shushenskoe Hydroelectric Station,
W89-00074 8C

Performance of Buried Small Pipes,
W89-00754 8A

Simplified Turbine Runner Shows Good Cavitation Resistance,
W89-01003 8C

HYDRAULIC GATES
Flow Simulation Using Channel Network Model,
W89-00751 7B

HYDRAULIC GEOMETRY
Channel Change and Sediment Transport in Regulated U.K. Rivers,
W89-00958 2J

HYDRAULIC JUMP
Extreme Pressures in Hydraulic-Jump Stilling Basins,
W89-00896 8B

Size of the Concrete Part of a Combined Apron below Low-head Outlet Works,
W89-01175 8B

HYDRAULIC MACHINERY
Manufacture of Polyethylene Seals for High-head Gates of Hydraulic Structures,
W89-00043 8G

Optimization of the Mud Intakes of Dredges with Submersible Pumps,
W89-00044 8C

Excavation of Heavy Soils by Dredges,
W89-00068 8H

Increase of the Reliability and Convenience of Operation of the Group Active Power Regulation System of a Hydroelectric Station,
W89-01179 8C

HYDRAULIC MODELS
Outlet Structure Design for Conduits and Tunnels,
W89-00307 8A

Catalyst for Regionalization of Rural Water Systems,
W89-00883 6E

Horizontal Round Buoyant Jet in Shallow Water,
W89-00902 5E

HYDRAULIC PERMEABILITY
Hydrogeology of Two Saskatchewan Tills. I. Fractures, Bulk Permeability, and Spatial Variability of Downward Flow,
W89-01201 2F

HYDRAULIC PROPERTIES
Impact of Rainfall and Soil Hydraulic Property Information on Runoff Predictions at the Hillslope Scale,
W89-01246 2E

HYDRAULIC STRUCTURES
Assignment of the Characteristics of Clay-Rubble Soils in Watertight Components of Earth Dams,
W89-00036 8D

Prospects of Improving the Prediction of the Hazard of Rock Bursts During Tunneling,
W89-00038 8E

Technology of Casting Precast Pipeline Elements of the Kaisiadory's Pumped-Storage Station,
W89-00045 8F

Adjusting and Modernization of the System Converting Units to Synchronous Capacitor Operation at the Sayano-Shushenskoe Hydroelectric Station,
W89-00074 8C

Effective Coatings for Hydraulic Structures,
W89-00075 8G

Hydrodynamic-Stiffness Matrix Based on Boundary Elements for Time-Domain Dam-Reservoir-Soil Analysis,
W89-00447 8B

Transient Pressures in Hydrotechnical Tunnels During Earthquakes,
W89-00448 8E

Planning and Construction of the Pahalgam Scheme,
W89-01004 8A

Complex Geology Leads to an Unusual Design for the Lakhwar Dam,
W89-01005 8E

China's Experience with Underground Works,
W89-01007 8H

Improvement of the Layouts and Design of Underground Hydraulic Structures,
W89-01172 8E

Size of the Concrete Part of a Combined Apron below Low-head Outlet Works,
W89-01175 8B

Some Results of Investigating the State of the Powerhouse of the Plyavinyas Hydroelectric Station,
W89-01180 8D

HYDRAULIC TURBINES
Set of Documents for Overhauling RO400-960-11 Turbines of the Inguri Hydroelectric Station,
W89-00060 8C

HYDRAULICS
Analysis of Turbulent Buoyant Jet in Density-Stratified Water,
W89-00491 5B

Mixing of Temperature-Stratified Lakes and Reservoirs by Buoyant Jets,
W89-00492 5G

Flow Simulation Using Channel Network Model,
W89-00751 7B

Alluvial Channel Hydraulics,
W89-01017 2J

HYDROBIOLOGY
Simple Self-Acting Hydrobiological Sampler (Prosty samoczynny czerpacz hydrobiologiczny),
W89-00033 7B

HYDROCARBONS
Tumor Frequencies and Contaminant Concentrations in Brown Bullheads from an Industrialized River and a Recreational Lake,
W89-00028 5C

Aliphatic and Polycyclic Aromatic Hydrocarbons in Urban Rain, Snow and Fog,
W89-00309 5B

Effects of Co-Occurring Aromatic Hydrocarbons on Degradation of Individual Polycyclic Aromatic Hydrocarbons in Marine Sediment Slurries,
W89-00339 5B

Seasonal and Temporal Changes of Organic Compounds in Rain and Snow,
W89-00429 5B

Sediment-Water Partition Coefficients and HPLC Retention Factors of Aromatic Hydrocarbons,
W89-00560 5B

Photo-induced Toxicity of Polycyclic Aromatic Hydrocarbons to Larvae of the Fathead Minnow (Pimephales promelas),
W89-00595 5C

Creosote Compounds in Snails Obtained from Pensacola Bay, Florida, near an Onshore Hazardous-Waste Site,
W89-00611 5B

Biogeochemistry of Benz(a)anthracene at the Sediment-Water Interface,
W89-00612 5B

Analysis of Halogenated Polycyclic Aromatic Hydrocarbons in Urban Air, Snow and Automobile Exhaust,
W89-00613 5B

Comparison of Drinking Water Mutagenicity with Leaching of Polycyclic Aromatic Hydrocarbons from Water Distribution Pipes,
W89-00619 5C

Degradation of Polycyclic Aromatic Hydrocarbons: III. Reaction Products of the Ozonolysis of Further Polycyclic Aromatic Hydrocarbons in Aqueous Systems (Zum Abbau von Polycyclischen Aromatischen Kohlenwasserstoffen: III. Reaktionsprodukte der Umsetzung von Weiteren Polycyclischen Aromatischen Kohlenwasserstoffen in Wasser mit Ozon),
W89-00739 5F

Hydrocarbons in Nigg Bay Sediments,
W89-00790 5B

Toxicity of Sea-Surface Microlayer: Effects On Herring and Turbot Embryos,
W89-00855 5C

Toxicity of Sea-Surface Microlayer: Effects of Hexane Extract on Baltic Herring (Clupea harengus) and Atlantic Cod (Gadus morhua) Embryos,
W89-00856 5C

Use of Total Organic Carbon as an Indicator of Contamination from an Oil Refinery, South-Central Kansas,
W89-00942 5A

Accumulation of Polycyclic Aromatic Hydrocarbons in Acid Sensitive Lakes,
W89-01074 5B

Atmospheric Deposition of Polycyclic Aromatic Hydrocarbons to Water Surfaces: A Mass Balance Approach,
W89-01257 5B

HYDRODYANAMICS

Hydrodynamic-Stiffness Matrix Based on Boundary Elements for Time-Domain Dam-Reservoir-Soil Analysis,
W89-00447 8B

HYDRODYNAMICS

Water Movement and the Simulation of Storm Surges in the Firth of Clyde,
W89-00803 2L

Measurement of Shallow Water Wave Direction for Longshore Sediment Transport,
W89-01082 2J

HYDROELECTIC POWER

Planning and Construction of the Pahalgam Scheme,
W89-01004 8A

HYDROELECTRIC PLANT

Politics of Hydro-Megaprojects: Damming with Faint Praise in Australia, New Zealand, and British Columbia,
W89-00836 6E

HYDROELECTRIC PLANTS

Control of the Conditions for Input of Hydropower Into the Unified Power System of the U.S.S.R.,
W89-00034 8C

Seismic Stress State of Underground Structures with Consideration of the Effect of the Free Surface,
W89-00035 8E

Calculation of Seismic Safety of Tunnels During Blasting,
W89-00037 8E

Introduction of New Technology on the Construction of the Shamkhor Hydroelectric Station,
W89-00039 8A

Water-Management Significance of the Moscow Canal,
W89-00050 3B

Power Facilities of the Moscow Canal,
W89-00053 8C

Hydropower Equipment of the Moscow Canal,
W89-00054 8C

Small Hydroelectric Stations and Prospects of Their Development,
W89-00059 8C

Set of Documents for Overhauling RO400-960-11 Turbines of the Inguri Hydroelectric Station,
W89-00060 8C

Improvement of the Effectiveness of Spillway Operation of High-Head Hydroelectric Stations,
W89-00067 8B

Preservation of Natural Fish Reproduction during Hydrotechnical Construction on Rivers,
W89-00069 8I

Adjusting and Modernization of the System Converting Units to Synchronous Capacitor Operation at the Sayano-Shushenskoe Hydroelectric Station,
W89-00074 8C

Experiences With the Assessment of the Residual Water Flow in Regulated Water Courses in the Salzburg Region (Erfahrungen bei der Beurteilung der Restwasserfuhrung von Ausleitungsstrecken im Land Salzburg),
W89-00164 4A

Reconstruction of the Surge Tank of the Sengilei Hydroelectric Station,
W89-00546 8C

Experience in Operating Hydraulic Structures and Equipment of Hydroelectric Stations,
W89-00554 8C

Application of Principal Component Analysis to Long-Term Reservoir Management,
W89-00698 6A

Hydropower Development on Rivers in Scotland,
W89-00952 8C

Dongjiang: A 500 MW Hydro Plant for Hunan Province,
W89-01001 8C

Intensive Hydro Development of the Hongshui River,
W89-01002 8C

Simplified Turbine Runner Shows Good Cavitation Resistance,
W89-01003 8C

Planning and Construction of the Pahalgam Scheme,
W89-01004 8A

Complex Geology Leads to an Unusual Design for the Lakhwar Dam,
W89-01005 8E

China's Experience with Underground Works,
W89-01007 8H

Increase of the Reliability and Convenience of Operation of the Group Active Power Regulation System of a Hydroelectric Station,
W89-01179 8C

Some Results of Investigating the State of the Powerhouse of the Plyavinyas Hydroelectric Station,
W89-01180 8D

Ultrasonic Flowmeter for Testing Units of Large Hydroelectric and Pumped-Storage Stations,
W89-01181 8C

Water Supply Yields Power,
W89-01254 8C

Lightning Spurs Hydro Rehab,
W89-01255 8C

HYDROELECTRIC POWER

Control of the Conditions for Input of Hydropower Into the Unified Power System of the U.S.S.R.,
W89-00034 8C

New Life for Small Hydroelectric Stations in Kirgizia,
W89-00042 8C

Future Prospects for Hydro Electricity and Windpower,
W89-00793 6C

Tidal Power Ruffles Feathers,
W89-00850 8A

HYDROELECTRIC STATIONS

Experience in Determining the Numerical Characteristics of Landslide Movements,
W89-00551 8A

Modification of Turbine Runner Blades at the Chirkey Hydroelectric Station,
W89-00555 8C

HYDROELELECTRIC PLANTS

New Life for Small Hydroelectric Stations in Kirgizia,
W89-00042 8C

HYDROGEN ION CONCENTRATION

Effect of Low pH on Survival of Brook Trout Embryos and Yolk-Sac Larvae in West Virginia Streams,
W89-00293 5C

Does pH Affect Fish Species Richness when Lake Area is Considered,
W89-00324 2H

Influence of pH and Ammonia Salts on Ammonia Toxicity and Water Balance in Young Channel Catfish,
W89-00377 5C

Effect of pH and Total Ion Concentration on Growth Rate of Chironomus nr. maturus Larvae (Diptera: Chironomidae) from an Acid Strip-Mine Lake,
W89-00399 5C

Diurnal Changes of pH Distribution and the Cascading of Shore Water in a Sargassum Forest,
W89-00682 2L

Role of Chemical Weathering in the Neutralization of Acidic Deposition,
W89-00696 5B

Provisional Diagenetic Model for pH in Anoxic Porewaters: Application to the FOAM Site,
W89-00767 2J

Potential Importance of Spatial and Temporal Heterogeneity in pH, Al, and Ca in Allowing Survival of a Fish Population: A Model Demonstration,
W89-01052 5C

Comparative Sensitivities of Bluegill, Channel Catfish and Fathead Minnow to pH and Aluminum,
W89-01098 5C

HYDROGEN ION CONCENTRATION

Sorption and Degradation of Aldicarb and Its Oxidation Products in a Soil-Water Flow System as a Function of pH and Temperature,
W89-01164 5B

Hydrogen Ion Concentration and Alkalinity of Reservoir Water in the Sierra Nevada, California, and Correlations with Air Pollutants,
W89-01165 5B

HYDROGEN ISOTOPES

Stable Isotope Study of Recharge Processes in the English Chalk,
W89-01197 2F

HYDROGEN PEROXIDE

Effects of Aquatic Humic Substances on Analysis for Hydrogen Peroxide Using Peroxidase-Catalyzed Oxidations of Triarylmethanes or p-Hydroxyphenylacetic Acid,
W89-00634 7B

HYDROGEN SULFIDE

Effect of Sulfate and Organic Matter on The Hydrogen Sulfide Formation in Biofilms of Filled Sanitary Sewers,
W89-00510 5D

Evaluation of Chemical Oxidizers for Hydrogen Sulfide Control,
W89-01129 5D

HYDROGRAPHS

Use of Plant Micro-Nutrient and Chlorophyll Records as Indices of Eutrophication in Inshore Waters,
W89-00160 5A

HYDROGRAPHY

Hydrography and Plankton of the Moray Firth,
W89-00778 2L

Clyde Sea Hydrography,
W89-00802 2L

Hydrography of Irvine Bay and Its Relation to the Clyde Sea Area,
W89-00805 2L

HYDROLOGIC BUDGET

Background Aspects of Lake Restoration: Water Balance, Heavy Metal Content, Phosphorus Homeostasis,
W89-00014 2H

Peatland Soil-Plant Relationships in the New Forest,
W89-00122 2H

Repercussions of a CO2 Doubling on the Water Cycle and on the Water Balance - A Case Study for Belgium,
W89-00355 2A

Evaporation from Mackenzie Delta Lakes, N.W.T., Canada,
W89-00438 2D

Stochastic Forecast of Water Losses,
W89-00759 7B

Groundwater Recharge in Arid Regions: Review and Critique of Estimation Methods,
W89-00914 2F

Assessing the Influence of Environmental Parameters on the Hydrological Cycle,
W89-00916 2A

HYDROLOGIC CYCLE

Repercussions of a CO2 Doubling on the Water Cycle and on the Water Balance - A Case Study for Belgium,
W89-00355 2A

Aragonite-to-Calcite Transformation During Fresh-Water Diagenesis of Carbonates: Insights from Pore-Water Chemistry,
W89-01076 2K

Role of Soil Organic Matter in the Geochemical Cycling of Chloride and Bromide,
W89-01200 2A

HYDROLOGIC DATA COLLECTIONS

Annual Flow Statistics for Ungaged Streams in Idaho,
W89-00753 7C

Satellite Data and Geographical Information System for Land Use Classification,
W89-00756 7B

Maximum Entropy Spectral Analysis of Hydrologic Data,
W89-01248 2A

HYDROLOGIC EQUATION

Assessing the Influence of Environmental Parameters on the Hydrological Cycle,
W89-00916 2A

HYDROLOGIC MODELS

Repercussions of a CO2 Doubling on the Water Cycle and on the Water Balance - A Case Study for Belgium,
W89-00355 2A

Multidimensional Modeling of Cumulative Rainfall: Parameter Estimation and Model Adequacy through a Continuum of Scales,
W89-00706 2B

Drainage Basin Control of Acid Loadings to Two Adirondack Lakes,
W89-00710 5B

Predicting Regional Episodic Acidification of Surface Waters Using Empirical Models,
W89-00719 5B

Evaluation of a Homogeneous Point Process Description of Arizona Thunderstorm Rainfall,
W89-00724 2B

Evaluating Peat-Mining Hydrology Using DRAINMOD,
W89-00755 4C

Stochastic Forecast of Water Losses,
W89-00759 7B

Progress in Developing an Operational Snowmelt-Runoff Forecast Model with Remote Sensing Input,
W89-00891 2A

Estimation of Catchment Rainfall Uncertainty and its Influence on Runoff Prediction,
W89-00892 2A

Multivariate Periodic ARMA (1,1) Processes,
W89-00967 7B

Approximate Confidence Intervals for Verification Criteria of the WMO Intercomparison of Snowmelt Runoff Models,
W89-01143 2E

HYDROLOGIC REGIME

Ecohydrological Approach to Floral and Vegetational Patterns in Arctic Landscape Ecology,
W89-00435 2H

HYDROLOGICAL ATMOSPHERIC PILOT EXPERIMENT

Macrohydrology: The New Challenge for Process Hydrology,
W89-01012 2A

HYDROLOGICAL CYCLE

Assessing the Influence of Environmental Parameters on the Hydrological Cycle,
W89-00916 2A

HYDROLOGICAL REGIME

Effect of the Hydrological Regime on Primary Production in the Main Stream and the Side Arms of the River Danube,
W89-00162 2H

HYDROLOGY

Hydrological Features of Poyang Lake, (in Chinese),
W89-00532 2H

Hydrological Perspective,
W89-01011 2A

Macrohydrology: The New Challenge for Process Hydrology,
W89-01012 2A

Status of Isotope Hydrology Today,
W89-01018 2A

Remote Sensing in Hydrology,
W89-01019 2A

Methods and Merits of Regional Flood Frequency Analysis,
W89-01020 2E

Hillslope Runoff Processes and Models,
W89-01022 2A

Rainfall-Runoff Modeling: Past, Present and Future,
W89-01023 2A

Hydrological Heterogeneity Catchment Morphology and Catchment Response,
W89-01024 2A

Groundwater Flow and Transport Modeling,
W89-01025 2F

Soil Physics and Hydrology,
W89-01026 2G

Contaminant Hydrogeology Dollars and Sense,
W89-01028 5B

HYPERTROPHIC LAKES

Zooplankton Community Grazing in a Hypertrophic Lake (Hartbeespoort Dam, South Africa),
W89-00220 2H

Sedimentation of Phytoplankton Populations Dominated by Microcystis in a Shallow Lake,
W89-00233 2H

Changes in Chlorophyll Contents of Swietokrzyskie Lake Phytoplankton, as Related to Qualitative and Quantitative Fluctuations of Phytoplankton Density and of the Physicochemical Conditions in this Lake in Summer 1979,
W89-00257 5C

Qualitative and Quantitative Changes in Phytoplankton on the Background of Physicochemical Changes in the Water of Swietokrzyskie Lake in the Years 1977-1979,
W89-00258 5C

HYPERTROPIC LAKES

Measurement of Primary Productivity in a High-Rate Oxidation Pond (HROP),
W89-00213 2H

HYPOLIMNION

Origin and Size of Hypolimnic Mixing in Urnersee, the Southern Basin of Vierwaldstattersee (Lake Lucerne),
W89-00023 2H

Biochemical Models for the Hypolimnetic Oxygen Depletion in Lakes Impacted by Wastewater Discharges: 2. Phytoplankton Biomass Model,
W89-00189 5C

HYPOXIA
Diurnal Distribution and Behavioral Responses of Fishes to Extreme Hypoxia in an Amazon Floodplain Lake,
W89-00331 2H

ICE
Creep of Ice Measured with the Pressuremeter,
W89-00387 2C

Vertically Integrated Snow/Ice Model over Land/Sea for Climate Models: 1. Development,
W89-01260 2C

Vertically Integrated Snow/Ice Model over Land/Sea for Climate Models: 2. Impact on Orbital Change Experiments,
W89-01261 2C

ICE COVER
Thermal Simulation of a Lake with Winter Ice Cover,
W89-01044 2H

ICE COVERS
Capacity of Ice-Covered Canals,
W89-01177 8B

ICE FORMATION
Secondary Ice Nucleus Generation by Silver Iodide Applied to the Ground,
W89-00088 3B

ICE LENSES
Subsoil Investigation of Ice Lensing at the Calgary, Canada, Frost Heave Test Facility,
W89-00389 2C

IDAHO
Annual Flow Statistics for Ungaged Streams in Idaho,
W89-00753 7C

ILLINOIS
Macroinvertebrate Populations in a Thermally Impacted Reservoir,
W89-00397 5C

ILLINOIS RIVER
Long-Term Ecological Research on Illinois Rivers,
W89-00401 2H

IMMOBILIZATION
Immobilization of Leachable Toxic Soil Pollutants by Using Oxidative Enzymes,
W89-00341 5G

IMPAIRED WATER QUALITY
Effects of Discontinuing Disinfection on a Receiving Water,
W89-00515 5D

IMPAIRED WATER USE
Possibility of Using Radioactively Polluted Waterbodies for Fish Culture,
W89-01193 3C

IMPEDANCE
In-Situ Method for Monitoring Layered Hydraulic Impedance Development During Artificial Recharge with Turbid Water,
W89-01205 2F

INCINERATION
Emissions of Chlorinated Organics from a Municipal Sewage Sludge Burning Incinerator,
W89-00607 5B

INDEX OF BIOTIC INTEGRITY
Spatial and Temporal Variability of the Index of Biotic Integrity in Three Midwestern Streams,
W89-00026 2E

INDIA
Heavy-Metal Toxicity in the Cyanobacterium Nostoc linckia,
W89-00094 5C

Species Diversity of Algal Flora in Vishwamitri River, Baroda (India),
W89-00234 2H

Thermal Ecology of Surinsar, a Subtropical Freshwater Lake in Jammu, India,
W89-00242 2H

Mercury Pollution in the Estuarine Region around Bombay Island,
W89-00638 5B

Improving Canal Water Deliveries with Auxiliary Storage,
W89-00758 3B

Planning and Construction of the Pahalgam Scheme,
W89-01004 8A

Complex Geology Leads to an Unusual Design for the Lakhwar Dam,
W89-01005 8E

Sediment Transport of the Godavari River Basin and Its Controlling Factors,
W89-01211 2J

INDIAN WATER RIGHTS
Water Rights: Enforcing the Federal-Indian Trust after Nevada v. United States,
W89-01010 6E

INDIANA
Planning Indiana's Water Infrastructure from a Competitive Perspective,
W89-00880 6B

Nitrilotriacetic Acid (NTA) Environmental Monitoring Program in Indiana: 1979 to 1983,
W89-01089 5A

INDIGO CARMINE
Adsorption of Indigo Carmine by Activated Carbon,
W89-00633 5D

INDUSTRIAL WASTES
Loss of Seagrass in Cockburn Sound, Western Australia: II. Possible Causes of Seagrass Decline,
W89-00116 5C

Some Hydrochemical, Hydrobiological, and Ichthyological Features of Yugoslav Part of the Danube Lasting for Several Years (Einige hydrochemische, hydrobiologische und ichthyologische Eigenschaften der jugoslawischen Donaustrecke in mehrjahrigem Zeitraum),
W89-00165 5C

Characteristics of Distribution and Migration of Phosphorus in Deposits of Dianchi Lake, (in Chinese),
W89-00200 5B

Lignin Residues as Tracers of Organic Waste Transport,
W89-00561 7B

Heavy Metal Pollution in the Guadiamar River and the Guadalquivir Estuary (South West Spain),
W89-00573 5B

Treatment of Dye-Containing Effluents with Different Bentonites,
W89-00615 5D

Interaction of Earthen Liner Materials with Industrial Waste Leachate,
W89-00997 5E

In situ Adapation of Activated Sludge by Shock Loading to Enhance Treatment of High Ammonia Content Petrochemical Wastewater,
W89-01127 5D

Dissolution of Trace Metals from Particles of Industrial Origin and Its Influence on the Composition of Rainwater,
W89-01149 5B

INDUSTRIAL WASTEWATER
Determination of Naphthenic Acids in California Crudes and Refinery Wastewaters by Fluoride Ion Chemical Ionization Mass Spectrometry,
W89-00209 5A

Instrumentation for 7-Day Continuous Cycle Monitoring of Metals with Automated On-Line Sample Preparation, High-Performance Liquid Chromatography, and Electrochemical Detection,
W89-00210 5A

Application of Headspace Gas Chromatography to the Monitoring of Organic Substances in Industrial Effluent,
W89-00572 5A

Formation of Hydrous Zirconium (IV) Oxide Polyelectrolyte Membranes, I. Poly (itaconic acid) and Poly (acrylic-co-itaconic acid),
W89-01062 3A

Biosorption of Organic Halide in a Kraft Mill Generated Lagoon,
W89-01138 5D

MCRT for Control of Cokemaking Wastewater treatment,
W89-01139 5D

INFILTRATION
Effect of Assumed Unit Gradient During Drainage on the Determination of Unsaturated Hydraulic Conductivity and Infiltration Parameters,
W89-00407 2G

Intrapedal Macropore Distribution and Infiltration Rate of Three Friona Polypedons,
W89-00408 2G

Effect of Sodium Nitrate and Gypsum on Infiltration and Erosion of a Highly Weathered Soil,
W89-00409 2G

Steady Unsaturated Seepage above a Sloping Impermeable Base,
W89-00726 2G

Infiltration under Ponded Conditions: 2. Infiltration Equations Tested for Parameter Time-Dependence and Predictive Use,
W89-00740 2G

Horizontal Infiltration of Water in Soil Columns as Affected by a Gel-Forming Conditioner,
W89-00741 2G

Subsurface Drainage Peak Flows in Shallow Soil,
W89-00749 4A

Explicit Solution to Green-Ampt Equation for Nonuniform Soils,
W89-00760 7B

Provisional Diagenetic Model for pH in Anoxic Porewaters: Application to the FOAM Site,
W89-00767 2J

Fog Drip as a Source of Groundwater Recharge in Northern Kenya,
W89-00984 2F

INFORMATION SYSTEMS
Satellite Data and Geographical Information System for Land Use Classification,
W89-00756 7B

INFORMATION SYSTEMS

Modern Management Standards of Water Network Register (Criteres Modernes de Gestion du Cadastre des Reseaux d'Eau),
W89-00919 5F

INFORMATION VALUE
Ex Post Analysis of Flood Control: Benefit-Cost Analysis and the Value of Information,
W89-00983 6C

INFRARED IMAGERY
Estimation of Bare Soil Evaporation from Airborne Measurements,
W89-00352 7B

INJECTION WELLS
Microbial Biomass, Activity, and Community Structure of Water and Particulates Retrieved by Backflow from a Waterflood Injection Well,
W89-00334 5B

INLETS
Flow Regimes and Dynamic Equilibrium of Morphological Changes at Koycegiz Lake Inlet, Turkey,
W89-00449 8B

INORGANIC COMPOUNDS
Sensitivity of Young Striped Bass to Organic and Inorganic Contaminants in Fresh and Saline Waters,
W89-00320 5C

INSECTICIDES
Effects of Lindane and Atropine Sulphate on the Tissues of the Fish, Anabas testudineus (Bloch): A Chronotoxicological Approach,
W89-00594 5C

INSECTS
Effects of Simulated Acidic Precipitation on Plant-Insect Interactions in Agricultural Systems: Corn and Black Cutworm Larvae,
W89-01160 5C

INSPECTION
Reliability and Safety Inspection of Hydraulic Structures of the Moscow Canal,
W89-00051 8A

Some Results of Investigating the State of the Powerhouse of the Plyavinyas Hydroelectric Station,
W89-01180 8D

INSTITUTIONS
Technology, Institutions, and Social Goals,
W89-00871 6D

INSTREAM FLOW
Influence of Temperature on Microhabitat Choice by Fishes in a California Stream,
W89-00027 2H

Microhabitat Use by an Assemblage of California Stream Fishes: Developing Criteria for Instream Flow Determinations,
W89-00319 6D

Effects of Temperature and Streamflow on Time and Duration of Spawning by Smallmouth Bass,
W89-00373 2H

INTAKES
Risk Analysis for Fish Diversion Experiments: Pumped Intake Systems,
W89-00318 8I

INTERBASIN TRANSFERS
Impact of River Regulations on Invertebrate Communities in the U.K.,
W89-00959 4A

INTERMITTENT STREAMS
Dry Stream Reaches in Carbonate Terranes: Surface Indicators of Ground-Water Reservoirs,
W89-00870 7B

INTERNATIONAL AGREEMENTS
Water Supply and Sanitation - Cornerstones of the World Health Organization's Forty Years of International Health Development,
W89-00917 5F

INTERNATIONAL COMMISSIONS
International Control of Cross-Media Pollution: An Ecosystem Approach,
W89-00520 5G

INTERNATIONAL LAW
Global Environment: A Proposal to Eliminate Marine Oil Pollution,
W89-00521 5G

INTERSTITIAL WATER
Comparison of Nutrients in the Interstitial Water of Reducing (Tamar Estuary) and Oxic (Carmarthen Bay) Coastal Sediments,
W89-00156 2L

Simple, Reliable, and Inexpensive Pore-Water Sampler,
W89-01051 7B

Aragonite-to-Calcite Transformation During Fresh-Water Diagenesis of Carbonates: Insights from Pore-Water Chemistry,
W89-01076 2K

Trace Metal Geochemistry of Pore Water Brines from Two Hypersaline Lakes,
W89-01079 2K

INTERTIDAL AREAS
Effects of Sediment Properties on Benthic Primary Production in the Columbia River Estuary,
W89-00115 2L

Population Dynamics of a Tropical Intertidal and Deep-Water Population of Sargassum polyceratium (Phaeophyceae),
W89-00528 2L

Effects on the Benthic Fauna of Embanking an Intertidal Flat Area (The Markiezaat, Eastern Scheldt Estuary, The Netherlands),
W89-00676 6G

Microbial-Meiofaunal Interrelationships in Some Tropical Intertidal Sediments,
W89-00766 2L

Intertidal Macrofauna of Nigg Bay,
W89-00780 2L

Active Emergence of Meiofauna from Intertidal Sediment,
W89-01037 2L

INVERTEBRATES
Indicatory Role of Some Invertebrates for Quality of Water in the Vistula River and in Subsequent Stages of Its Treatment,
W89-00236 5A

Impact of a Municipal Wastewater Effluent on Water Quality, Periphyton, and Invertebrates in the Little Miami River Near Xenia, Ohio,
W89-00685 5C

Moray Firth Marine Fouling Communities,
W89-00781 2L

Impact of River Regulations on Invertebrate Communities in the U.K.,
W89-00959 4A

ION CHROMATOGRAPHY
Determination of Nitrate at the Ng/g Level in Antarctic Snow Samples with Ion Chromatography and Isotope Dilution Mass Spectrometry,
W89-00269 5A

ION EXCHANGE
Role of Chemical Weathering in the Neutralization of Acidic Deposition,
W89-00696 5B

Copper, Nickel, and Chrome Recovery in a Jobshop to Eliminate Waste Treatment and Sludge Disposal,
W89-00993 5D

Operating a Small Full-Scale Ion Exchange System for Uranium Removal,
W89-01107 5F

ION-SELECTIVE ELECTRODES
Indirect Trace Determination of Ethylenediaminetetraacetic Acid (EDTA) in Water by Potentiometric Stripping Analysis,
W89-00481 5A

IONS
Chemical Environment of Salvinia molesta Mitchell: Ionic Concentrations of Infested Waters,
W89-00106 5B

General Correction for Spontaneous Potential Well Logs in Fresh Water,
W89-01195 7B

IOWA
Regional Hydrogeology of Agricultural Drainage Wells in Iowa,
W89-00471 5B

IRAQ
Residual Fluxes of Water in an Estuarine Lagoon,
W89-00142 2L

Some Biological Aspects of Liza abu (Heckel) mugilidae, in AL-Daoodi Drain, (Baghdad, Iraq),
W89-00890 2H

Sediments in the Estuarine Environment of the Tigris/Euphrates Delta; Iraq; Arabian Gulf,
W89-01083 2L

Characteristics of the Organization and Performance of Works in the Dam Foundation of the Al-Hadithah Hydro Development (Iraq),
W89-01182 8F

IRON
Dynamics of Iron and Manganese in the Surface Sediments of a Seasonally Anoxic Lake,
W89-00188 2H

Seasonal Change of Iron and Manganese in Lake Fukami-ike: Occurrence of Turbid Manganese Layer,
W89-00770 2H

Microporous Filters with Oxidizing Power for Iron and Manganese Removal from Water,
W89-00889 5F

Solubility of Colloidal Ferric Hydroxide and its Relevance to Iron Concentrations in River Water,
W89-01081 2K

IRON OXIDES
Iron Oxide Formation in Artificial Ground Waters,
W89-00687 2F

IRRIGATION
Intrapedal Macropore Distribution and Infiltration Rate of Three Friona Polypedons,
W89-00408 2G

Water Management for Lowland Rice Irrigation,
W89-00750 3F

IRRIGATION CANALS
Effect of Several Methods of Aquatic Plant Control on Two Bilharzia-Bearing Snail Species,
W89-00117 4A

Implications of Public Ownership of Irrigation Canal Systems in the Texas Rice Belt: Impacts on Water Use and Water Price,
W89-00460 6E

Improving Canal Water Deliveries with Auxiliary Storage,
W89-00758 3B

IRRIGATION EFFECTS
Microscale Haline Convection - A Proposed Mechanism for Transport and Mixing at the Water Table Region,
W89-00718 2F

IRRIGATION EFFICIENCY
Water Management for Lowland Rice Irrigation,
W89-00750 3F

Improving Canal Water Deliveries with Auxiliary Storage,
W89-00758 3B

IRRIGATION OPERATION
O and M Spending Levels in Third World Irrigation Systems: Exploring Economic Alternatives,
W89-00874 3F

IRRIGATION REQUIREMENTS
Water Management for Lowland Rice Irrigation,
W89-00750 3F

IRRIGATION WATER
Tisza Water, as Irrigation Water, Polluted with Various Compounds,
W89-00145 3C

IRVINE BAY
Hydrography of Irvine Bay and Its Relation to the Clyde Sea Area,
W89-00805 2L

ISOLATION
Efficacy of Chemical Dosing Methods for Isolating Nontuberculous Mycobacteria from Water Supplies of Dialysis Centers,
W89-00343 5A

ISOTHERMS
Multi-Component Sorption Isotherms of Basic Dyes onto Peat,
W89-00083 5D

ISOTOPE-DILUTION TECHNIQUE
Negative Thermal Ionization Mass Spectrometry of Selenium: Part 1. Isotope Ratio Measurements and Determinations in Aquatic Systems with the Isotope Dilution Technique (Negative Thermionen-Massenspektrometrie von Selen: Teil 1. Isotopenverhaeltnismessungen sowie Konzentrationsbestimmungen in Aquatischen Systemen mit der Isotopenverduennungsanalyse),
W89-00737 5A

ISOTOPE STUDIES
Measurement of Primary Productivity in a High-Rate Oxidation Pond (HROP),
W89-00213 2H

Body Size and Mass Flow in Freshwater Plankton: Models and Tests,
W89-00218 2H

Influence of the Vistula River on Distribution of 226Ra in the Gdansk Bay,
W89-00250 2K

Investigation of Transport-Processes along the Elbe River Using Chernobyl Radionuclides as Tracers,
W89-00636 5B

Chemistry and Delta 13C of Total Dissolved Carbon in Waters of Selected Springs Nearby Lublin City: Weekly Observations from October 1982 to June 1983,
W89-00895 2F

Tracing of Water Movement in the Unsaturated Zone Using Stable Isotopes of Hydrogen and Oxygen,
W89-01016 2G

Status of Isotope Hydrology Today,
W89-01018 2A

ISRAEL
Association Between Seawater Pollution as Measured by Bacterial Indicators and Morbidity Among Bathers at Mediterranean Bathing Beaches of Israel,
W89-00579 5C

ISTRINS RESERVOIR
State of the Ichthyofauna in Istrinsk Reservoir Since Its Conversion into a Recreational Water,
W89-01191 2H

ITALY
Sources of Watercourse Pollution in Italy and Mediterranean France, Assessed by Macrophytes,
W89-00563 5B

Seasonal Changes of the Profundal Macrobenthic Community in a Polluted Lake,
W89-00693 5C

ITCHEN RIVER
River Regulation by Seasonal Groundwater Abstraction: The Case of the River Itchen,
W89-00956 4B

JAMES BAY
Pipe Flow in James Bay Coastal Wetlands,
W89-00047 2A

JAPAN
River Improvement Planning for Flood Protection in the Kiso River Basin until the Meiji Era, (in Japanese),
W89-00204 4A

Inhabitants' Life in the Lowland of the Kiso, Nagara and Ibi Rivers, (in Japanese),
W89-00205 4A

Monitoring of PCDDs in Osaka Bay Using Blue Mussel,
W89-00604 5B

JETS
Analysis of Turbulent Buoyant Jet in Density-Stratified Water,
W89-00491 5B

Mixing of Temperature-Stratified Lakes and Reservoirs by Buoyant Jets,
W89-00492 5G

Horizontal Round Buoyant Jet in Shallow Water,
W89-00902 5E

JIANGHAN LAKES
Study of Modern Vicissitudes of the Jianghan Lake Group by Using Remote Sensing Techniques,
W89-00542 2H

JIRZHOU BAY
Preliminary Study on the Migration and Transformation of Heavy Metals in the Sewage-Seawater Mixing Zone of Jinzhou Bay, (in Chinese),
W89-00199 5B

JOHANNESBURG
Legionnaire's Disease in a Johannesburg Teaching Hospital,
W89-00450 5F

JORDAN CREEK
Baseline Study of Jordan Creek, City of Allentown, Lehigh County, Pennsylvania,
W89-00313 5C

JUDICIAL DECISIONS
Citizen Suits under the Clean Water Act: Waiting for Godot in the Fifth Circuit,
W89-00517 6E

Water Rights: Enforcing the Federal-Indian Trust after Nevada v. United States,
W89-01010 6E

JUNCUS
Biomass, Productivity and Life History Traits of Juncus militaris Bigel. in Two Rhode Island (U.S.A.) Freshwater Wetlands,
W89-00100 2H

JURISDICTION
Coastal Management Issues for the Mouth of the River Murray, South Australia,
W89-01072 6E

Interjurisdictional Management in Chesapeake Bay Fisheries,
W89-01073 6E

KANAWHA RIVER
Fish Production in the Kanawha River and its Relation To Barge Traffic,
W89-00249 6G

KANSAS
Relations Between Habitat Variables and Channel Catfish Populations in Prairie Streams,
W89-00325 2H

Summary of Reported Fish Kills in Kansas During 1982,
W89-00393 5C

Variations of Runoff in the High Plains Section of the Smoky Hill Drainage, 1951-1980,
W89-00394 2A

KARST HYDROLOGY
Storm Response of the Karstic Carbonate Aquifer of Southcentral Kentucky,
W89-00349 2A

MODALP: A Deterministic Rainfall-Runoff Model for Large Karstic Areas,
W89-01145 2F

KARST HYDROLOGYY
Drawdown Interval Analysis: A Method of Determining the Parameters of Shallow Conduit Flow Carbonate Aquifers from Pumping Tests,
W89-00986 2F

KENYA
Regionalization of Daily Rainfall in Kenya by Means of Common Factor Analysis,
W89-00473 2B

Fog Drip as a Source of Groundwater Recharge in Northern Kenya,
W89-00984 2F

KHOWR AL-ZUBAIR
Residual Fluxes of Water in an Estuarine Lagoon,
W89-00142 2L

KINETICS
Statistical Considerations Associated with the Use of the Heterotrophic Activity Method for Estimating V sub max and K' for Aquatic Environments,
W89-00280 7C

KINETICS

Effect of Culture History on the Determination of Biodegradation Kinetics by Batch and Fed-Batch Techniques,
W89-00513 5D

Micromixing and Dispersion in Chlorine Contact Chambers,
W89-00622 5D

Basic Encoded Model for One-Dimensional Ground Water Systems Incorporating First-Order Degradation Kinetics,
W89-00888 5B

Numerical Modeling of Sorption Kinetics of Organic Compounds to Soil and Sediment Particles,
W89-00981 5B

Reactivity of the Carbonate Radical with Aniline Derivatives,
W89-01088 5B

Aerobic Biodegradation of Natural and Xenobiotic Organic Compounds By Subsurface Microbial Communities,
W89-01090 5B

Evaluation of Chemical Oxidizers for Hydrogen Sulfide Control,
W89-01129 5D

Kinetics of Sulfide Oxidation by Dissolved Oxygen,
W89-01130 5D

Kinetics and Reaction Engineering of Anaerobic Sewage Treatment (Kinetik und Reaktionstechnik der anaeroben Abwasserreinigung),
W89-01185 5D

Determination of Microbial Kinetic Coefficients through Measurement of Initial Rates by Radiochemical Techniques,
W89-01218 5D

KISO RIVER BASIN

River Improvement Planning for Flood Protection in the Kiso River Basin until the Meiji Era, (in Japanese),
W89-00204 4A

Inhabitants' Life in the Lowland of the Kiso, Nagara and Ibi Rivers, (in Japanese),
W89-00205 4A

KOWIE RIVER

Flux of Organic Carbon in a Tidal Salt Marsh, Kowie River Estuary, Port Alfred, South Africa,
W89-00453 2L

KRIGING

Geostatistics Applied to Groundwater Pollution: III. Global Estimates,
W89-00493 5B

Estimation of Catchment Rainfall Uncertainty and its Influence on Runoff Prediction,
W89-00892 2A

KUPA RIVER

Polychlorinated Biphenyls in the Kupa River, Croatia, Yugoslavia,
W89-00609 5B

LABORATORIES

Reliability of Chemical Analyses of Water Samples: The Experience of the UMTRA Project,
W89-00941 5A

Utility of Laboratory Streams for Ecosystem Toxicity Studies,
W89-01059 5B

LAGOONS

Seasonal Abundance and Distribution of Drift Algae and Seagrasses in the Mid-Indian River Lagoon, Florida,
W89-00104 2L

Faunas of Land-Locked Lagoons: Chance Differences and the Problems of Dispersal,
W89-00141 2L

Residual Fluxes of Water in an Estuarine Lagoon,
W89-00142 2L

Use of Duckweed for Wastewater Treatment,
W89-01128 5D

Biosorption of Organic Halide in a Kraft Mill Generated Lagoon,
W89-01138 5D

LAKE ABAYA

Attempt to Estimate the Fish Stock and the Sustainable Yield of Lake Ziway and Lake Abaya, Ethiopian Rift Valley,
W89-00178 2H

LAKE ANNA

Interactions Between Groundwater Seepage and Sediment Porewater Sulphate Concentration Profiles in Lake Anna, Virginia,
W89-00910 5B

LAKE BALATON

Role of Storms in the Summer Succession of the Phytoplankton Community in a Shallow Lake (Lake Balaton, Hungary),
W89-00232 2H

LAKE CALADO

Nitrate and Ammonium Uptake by Plankton in an Amazon River Floodplain Lake,
W89-00229 2H

LAKE CAMPOTOSTO

Zooplankton Population of Man-Made Lakes in Abruzzi's Appennines: Campotosto Lake (Popolamento Zooplanctonico di un Lago di Sbarramento Dell'Appennino Abruzzese: Il Lago di Campotosto),
W89-00197 2H

LAKE CARIOCA

Decomposition Rates of Allochthonous Material (Litter) in Lake Carioca - Rio Doce Forest Park - MG (Taxa de Decomposicao do Material Aloctone 'Litter' na Lagoa Carioca - Parque Florestal do Rio Doce - Minas Gerias),
W89-00007 2H

LAKE CHARLESTON

Scour Channel Development after Spillway Failure,
W89-00897 2J

LAKE CLASSIFICATION

Natural Degradation Ability of Lakes and the Role of Drainage Area in the Process (Ocena naturalnej podatnosci jezior na degradacje i rola zlewni u tym procesie),
W89-00032 2H

LAKE CONSTANCE

Seasonal Productivity Cycle of Phytoplankton and Controlling Factors in Lake Constance,
W89-00022 2H

Quantum Yield as a Fundamental Parameter Controlling Vertical Photosynthetic Profiles of Phytoplankton in Lake Constance,
W89-00176 2H

Loss Processes Influencing Growth of Planktonic Bacterial Populations in Lake Constance,
W89-00217 2H

Bacterial Response to Seasonal Changes in Primary Production and Phytoplankton Biomass in Lake Constance,
W89-00225 2H

LAKE ERIE

Eutrophication Effects of Prey Size and Food Available to Yellow Perch in Lake Erie,
W89-00030 5C

Snail Distributions in Lake Erie: The Influence of Anoxia in the Southern Central Basin Nearshore Zone,
W89-00683 2A

Data Analysis of Water Quality Time Series in Lake Erie,
W89-00866 7C

LAKE ESROM

Population Dynamics and Production of Chironomidae (Diptera) at 2 m depth in Lake Esrom, Denmark,
W89-00182 2H

LAKE EUREKA

Experiences of Long-term Destratification in a Water Supply Impoundment in Central Illinois,
W89-00403 5G

LAKE EVAPORATION

Evaporation from Mackenzie Delta Lakes, N.W.T., Canada,
W89-00438 2D

LAKE FISHERIES

Feedback Dependence Between the Eutrophication Process and Changes in the Fish Community: The Theory of Ichthyoeutrophication (Sprzezenie zwrothe miedzy procesum eutrofizacji a zmianami zespolu ryb. Tesri ichtioeutrofizacji),
W89-00031 5C

Attempt to Estimate the Fish Stock and the Sustainable Yield of Lake Ziway and Lake Abaya, Ethiopian Rift Valley,
W89-00178 2H

LAKE GENEVA

Interpretation of Metal Profiles in a Sediment Core from Lake Geneva: Metal Mobility or Pollution,
W89-00694 5B

LAKE GREVELINGEN

Distribution, Dynamics and Productivity of a Colonizing (Polydora quadrilobata) and an Established (P. ligni) Polydorid Polychaete in Lake Grevelingen: An Enclosed Estuary in the SW Netherlands,
W89-00002 2H

LAKE HURON

Application of Ecological Modelling: Impact of Thermal Effluent on a Smallmouth Bass Population,
W89-00317 5C

LAKE KOYCEGIZ

Flow Regimes and Dynamic Equilibrium of Morphological Changes at Koycegiz Lake Inlet, Turkey,
W89-00449 8B

LAKE LUCERNE

Origin and Size of Hypolimnic Mixing in Urnersee, the Southern Basin of Vierwaldstattersee (Lake Lucerne),
W89-00023 2H

LAKE MALAREN

Phytoplankton and Reversed Eutrophication in Lake Malaren, Central Sweden, 1965-1983,
W89-01188 5G

LAKE MICHIGAN
Mesoscale Spiral Vortex Embedded within a Lake Michigan Snow Squall Band: High Resolution Satellite Observations and Numerical Model Simulations,
W89-00748 2B

LAKE NEMI
Seasonal Changes of the Profundal Macrobenthic Community in a Polluted Lake,
W89-00693 5C

LAKE PONTCHARTRAIN
Contributions of Heavy Metals from Municipal Runoff to the Sediments of Lake Pontchartrain, Louisiana,
W89-00618 5B

LAKE RESTORATION
Scientific Concepts and Methodologies Pertinent to Lake Research and Lake Restoration,
W89-00013 2H

Background Aspects of Lake Restoration: Water Balance, Heavy Metal Content, Phosphorus Homeostasis,
W89-00014 2H

Lake Restoration: Why Oxygenation and Artificial Mixing Cannot Substitute for a Decrease in the External Phosphorus Loading,
W89-00015 5G

Internal Elemental Cycles Affecting the Long-Term Alkalinity Status of Lakes: Implications for Lake Restoration,
W89-00016 5G

Strategies of Lake Sanitation,
W89-00017 5G

Response of Phytoplankton Communities to Changing Lake Environments,
W89-00018 2H

Food Web Manipulation Without Nutrient Control: A Useful Strategy in Lake Restoration,
W89-00019 5G

Chemical Methods of P-Elimination in the Tributaries of Reservoirs and Lakes,
W89-00020 5G

Evaluation of Lake Restoration in Sweden,
W89-00021 5G

Delayed Nutrient Responses to the Liming of Lake Gardsjon, Sweden,
W89-00441 5G

Lake Dredging Boosts Recreational and Esthetic Environments,
W89-00468 5G

Mixing of Temperature-Stratified Lakes and Reservoirs by Buoyant Jets,
W89-00492 5G

Intermittent Destratification: A Therapy Measure against Cyanobacteria in Lakes,
W89-00639 5G

Lake Treatment with Alum,
W89-00745 5G

Phytoplankton and Reversed Eutrophication in Lake Malaren, Central Sweden, 1965-1983,
W89-01188 5G

LAKE SEDIMENTS
Leaf Production and Nitrogen and Phosphorus Tissue Content of Littorella uniflora (L.) Aschers. in Relation to Nitrogen and Phosphorus Enrichment of the Sediment in Oligotrophic Lake Hampen, Denmark,
W89-00101 5C

Dynamics of Iron and Manganese in the Surface Sediments of a Seasonally Anoxic Lake,
W89-00188 2H

Chemical Characteristics of Bottom Sediment Top Layer in Szczytno Male Lake,
W89-00237 2H

Sorption of Cations by Bottom Sediments of Szczytno Male and Letowo Lakes, with Cage Trout Culture,
W89-00239 2H

Chernobyl 134Cs, 137Cs, and 210Pb in High Mountain Lake Sediment: Measurements and Modeling of Mixing Process,
W89-00271 5B

Numerical Model for the Wind-Driven Circulation in the Bot River Estuary,
W89-00652 2L

Interpretation of Metal Profiles in a Sediment Core from Lake Geneva: Metal Mobility or Pollution,
W89-00694 5B

Effects of Acidification on Mercury Methylation, Demethylation, and Volatilization in Sediments from an Acid-Susceptible Lake,
W89-00731 5B

Interactions Between Groundwater Seepage and Sediment Porewater Sulphate Concentration Profiles in Lake Anna, Virginia,
W89-00910 5B

Spatial Patchiness in the Lacustrine Sedimentary Environment,
W89-01048 2H

Toxicity of Alkyllead Salts to Anaerobic Nitrogen Transformations in Sediment,
W89-01167 5C

LAKE SEVAN
Fecundity Dynamics of Khramulya, Varicorhinus capoeta sevangi, in Relation to the Changing Environment of Lake Sevan,
W89-01194 2H

LAKE SHINJI
Studies on Formations and Changes of Micro-Stratification in Blackish Water Lake Shinji, (in Japanese),
W89-00772 2H

LAKE SHORES
Sources and Fate of Detritus in the Shore Zone of Lakes,
W89-00121 2H

Great Lakes Shore Erosion,
W89-00133 4D

LAKE SURINSAR
Thermal Ecology of Surinsar, a Subtropical Freshwater Lake in Jammu, India,
W89-00242 2H

LAKE TAHOE
Recurrence of Daphnia rosea in Lake Tahoe: Analysis of a Population Pulse,
W89-00216 2H

Summer Dynamics of the Deep Chlorophyll Maximum in Lake Tahoe,
W89-00224 2H

Seasonal Phytoplankton Demographic Processes and Experiments on Interspecific Competition,
W89-00906 2H

California Tahoe Conservancy: Applying the Principles,
W89-01068 6E

LAKE WATER
Degradation and Formation of Refractory DOM by Bacteria During Simultaneous Growth on Labile Substrates and Persistent Lake Water Constituents,
W89-00691 2H

LAKE ZIWAY
Attempt to Estimate the Fish Stock and the Sustainable Yield of Lake Ziway and Lake Abaya, Ethiopian Rift Valley,
W89-00178 2H

LAKES
Phytoplankton Composition of Stagnant and Tidal Ecosystems in Relation to Salinity, Nutrients, Light and Turbulence,
W89-00001 2L

Distribution, Dynamics and Productivity of a Colonizing (Polydora quadrilobata) and an Established (P. ligni) Polydorid Polychaete in Lake Grevelingen: An Enclosed Estuary in the SW Netherlands,
W89-00002 2H

Decomposition Rates of Allochthonous Material (Litter) in Lake Carioca - Rio Doce Forest Park - MG (Taxa de Decomposicao do Material Aloctone 'Litter' na Lagoa Carioca - Parque Florestal do Rio Doce - Minas Gerias),
W89-00007 2H

Freshwater Mollusks as Indicators of Trophic Conditions in Coastal Lakes of Southern Brazil (Moluscos Dulceaquicolas Como Indicadores de Condicoes Troficas em Lagoas Costeiras do Sul do Brasil),
W89-00008 5A

Origin and Size of Hypolimnic Mixing in Urnersee, the Southern Basin of Vierwaldstattersee (Lake Lucerne),
W89-00023 2H

Drift of Zooplankton in a Lake-Outlet (Glatt) in a Day-Night-Rhythm Depending from the Water Level,
W89-00025 2H

Tumor Frequencies and Contaminant Concentrations in Brown Bullheads from an Industrialized River and a Recreational Lake,
W89-00028 5C

Natural Degradation Ability of Lakes and the Role of Drainage Area in the Process (Ocena naturalnej podatnosci jezior na degradacje i rola zlewni u tym procesie),
W89-00032 2H

Effects of Fish Nests on Pattern and Zonation of Submersed Macrophytes in a Softwater Lake,
W89-00092 2H

Photosynthesis of Submersed Macrophytes in Acidified Lakes: II. Carbon Limitation and Utilization of Benthic CO2 Sources,
W89-00095 5C

Effects of the Season and of Water Chemistry on the Decomposition of Nymphaea alba L.: Weight Loss and Pyrolysis Mass Spectrometry of the Particulate Matter,
W89-00096 2H

Influence of Sediment Composition and Irradiance on the Growth and Morphology of Myriophyllum spicatum L.,
W89-00098 2H

Richness of Aquatic Macrophyte Floras of Soft Water Lakes of Differing pH and Trace Metal Content in Ontario, Canada,
W89-00103 5C

Sources and Fate of Detritus in the Shore Zone of Lakes,
W89-00121 2H

Growth Strategies and Distribution of Isoetids in Scottish Freshwater Lochs,
W89-00129 5C

Lake Enrichment by Submersed Macrophytes: A Norwegian Whole-Lake Experience with Elodea canadensis,
W89-00131 2H

Great Lakes Shore Erosion,
W89-00133 4D

Relationship between Zooplankton Development and Environmental Conditions in Different Types of Lakes in the Zone of Temperate Climate.
W89-00138 2H

Seasonal Fluctuations in the Species Composition of Phytoplankton and Phytobenthos in the Lobau Near Vienna (Jahreszeitliche Schwankungen in der Zusammensetzung des Phytoplanktons und Phytobenthos in Altwassern der Lobau bei Wien),
W89-00166 2H

Quantum Yield as a Fundamental Parameter Controlling Vertical Photosynthetic Profiles of Phytoplankton in Lake Constance,
W89-00176 2H

New Aspects of the Sulfur Cycle, with Special Reference to Shallow Waters,
W89-00183 5B

Benthic Cyanophyte Associations in Streams and Lakes (Benthische Cyanophyten-Gemeinschaften in Bachen und Seen),
W89-00184 2H

Physiological Ecology of Bluegreen Algal Mats (Modern Stromatolites) in Antarctic Oasis Lakes,
W89-00185 2H

Biochemical Models for the Hypolimnetic Oxygen Depletion in Lakes Impacted by Wastewater Discharges: 1. Alternative models,
W89-00186 5C

Dynamics of Iron and Manganese in the Surface Sediments of a Seasonally Anoxic Lake,
W89-00188 2H

Biochemical Models for the Hypolimnetic Oxygen Depletion in Lakes Impacted by Wastewater Discharges: 2. Phytoplankton Biomass Model,
W89-00189 5C

Periphyton Diatom Communities and Trophic States of Three Shallow Lakes in the Pfynwald Region of Canton Valais, Switzerland,
W89-00195 2H

Primary Studies on Population Dynamics of 3 Species of Cladocera (Waterflea) in Dianshan Lake, (in Chinese),
W89-00198 2H

Effects of Acidification on Metal Budgets of Lakes and Catchments,
W89-00207 5C

Primary Production in Lakes with Cage Trout Culture,
W89-00238 2H

Hydrochemical Study of Lake Szczytno Male With Trout Cage Culture,
W89-00241 5B

Thermal Ecology of Surinsar, a Subtropical Freshwater Lake in Jammu, India,
W89-00242 2H

Concentrations of Nitrogen and Phosphorus in Waters of Two Hypertrophic Lakes and Their Effect on the Quantity of Phytoplankton Biomass,
W89-00245 2H

Diurnal Fluctuations of Phosphorus Forms in Lake Water and Seston in Pluss-See,
W89-00246 2H

Limnocorral Experiments in a Eutrophic Lake - Effects of Fish on the Planktonic and Chemical Conditions,
W89-00253 2H

Patterns of Epipelic Algal Distribution in an Acidic Adirondack Lake,
W89-00298 2H

Does pH Affect Fish Species Richness when Lake Area is Considered,
W89-00324 2H

Diurnal Distribution and Behavioral Responses of Fishes to Extreme Hypoxia in an Amazon Floodplain Lake,
W89-00331 2H

Influence of an Arctic Large-Lakes System on Mesoclimate in South-Central Baffin Island, N.W.T., Canada,
W89-00437 2H

Evaporation from Mackenzie Delta Lakes, N.W.T., Canada,
W89-00438 2D

Eutrophication of Lakes and Reservoirs: A Framework for Making Management Decisions,
W89-00439 5C

Lake Dredging Boosts Recreational and Esthetic Environments,
W89-00468 5G

Mixing of Temperature-Stratified Lakes and Reservoirs by Buoyant Jets,
W89-00492 5G

Motor-Boat-Derived Volatile Organic Compounds (VOC) in Lake water,
W89-00499 5B

Structure of a Population of Lobelia dortmanna L. Along a Gradient of Increasing Depth in an Oligotrophic Lake,
W89-00525 2H

Seasonal Development of Lobelia Dortmanna L. and Annual Balance of Its Population Size in an Oligotrophic Lake,
W89-00526 2H

Demographic Study of Aerial Shoots of Carex rostrata in Relation to Water Level,
W89-00530 2H

Analysis and Assessment of Water Quantities in Lakes of China, (In Chinese),
W89-00531 2H

Hydrological Features of Poyang Lake, (in Chinese),
W89-00532 2H

Application of the Principle of Least Sigma to the Chemical Model of Natural Water, (in Chinese),
W89-00537 2H

Probing into the Computation Method on Sedimentary Amount of Poyang Lake, (in Chinese),
W89-00540 2H

Study of Modern Vicissitudes of the Jianghan Lake Group by Using Remote Sensing Techniques,
W89-00542 2H

Ecological Parameter of Surface Water in Northeastern Greece,
W89-00564 5B

Correlation of Some Organic Pollution Factors in Water Systems in Northern Greece,
W89-00566 5B

Comparative Study of Heavy Metals Pollution in Various Rivers and Lakes of Northern Greece,
W89-00571 5B

Snail Distributions in Lake Erie: The Influence of Anoxia in the Southern Central Basin Nearshore Zone,
W89-00683 2A

Dynamics of Hydra Populations in Lake Zurich, Switzerland, and Lake Maggiore, Italy,
W89-00692 2H

Drainage Basin Control of Acid Loadings to Two Adirondack Lakes,
W89-00710 5B

Comparison of Robust Bayes and Classical Estimators for Regional Lake Models of Fish Response to Acidification,
W89-00713 5C

Predicting Regional Episodic Acidification of Surface Waters Using Empirical Models,
W89-00719 5B

Lake Treatment with Alum,
W89-00745 5G

Vertical Distribution of Phytoplankton in a Stratified Lake (Lago Dom Helvecio, Southeastern Brazil) with Special Reference to the Metalimnion,
W89-00768 2H

Nitrogen Metabolism in the Brackish Lake Nakanoumi. III. Nitrification-Dentrification in Low Concentration of Dissolved Oxygen, (in Japanese),
W89-00769 2H

Utilization of Nitrogenous Nutrients by Natural Phytoplankton in Enriched Lake Waters,
W89-00773 2H

Distribution of Cadmium in Lake Tohya,
W89-00774 2H

Intercomparison of Four Mixed Layer Models in a Shallow Inland Sea,
W89-00831 2H

Data Analysis of Water Quality Time Series in Lake Erie,
W89-00866 7C

Tropical Eutrophic Lake Modeling and Parameter Discrimination,
W89-00872 2H

Sedimentation of Particulate Material in Two Shallow, Land-Locked Fjords in Western Norway,
W89-01008 2J

Thermal Simulation of a Lake with Winter Ice Cover,
W89-01044 2H

Spatial Patchiness in the Lacustrine Sedimentary Environment,
W89-01048 2H

Records of Riverborne Turbidity Currents and Indications of Slope Failures in the Rhone Delta of Lake Geneva,
W89-01049 2J

Myxococcal Predation on Cyanobacterial Populations: Nutrient Effects,
W89-01050 2H

Accumulation of Polycyclic Aromatic Hydrocarbons in Acid Sensitive Lakes,
W89-01074 5B

Trace Metal Geochemistry of Pore Water Brines from Two Hypersaline Lakes,
W89-01079 2K

Size Structure of Planktonic Crustaceans in a Dimictic Lake on the Canadian Shield (Structure en Taille des Crustaces Planctoniques d'un Lac Dimictique du Bouclier Canadien),
W89-01231 2H

Lake Response Modeling Using Biologically Available Phosphorus,
W89-01236 5C

LAKES *NITROGEN

Nitrogen and Phosphorus Balance in Lake Szczytno Male,
W89-00240 2H

LAMINAR FLOW

Modeling of Tracer Spreading in a Fracture in which the Aperture Decreases with Depth in a Laminar Flow (Modelisation de la Propagation d'un Traceur dans une Fracture qui se Ferme Progressivement en Profondeur dans l'Hypothese d'un Ecoulement Laminaire Parallele),
W89-01214 2F

LAND CLASSIFICATION

Satellite Data and Geographical Information System for Land Use Classification,
W89-00756 7B

LAND DEVELOPMENT

Stream Chemistry in the New Jersey Pinelands: The Influence of Precipitation and Watershed Disturbance,
W89-00716 5B

LAND DISPOSAL

Land Application of Domestic Wastewater, Wood Production, and Sludge Composting: An Economic and Energy Production Analysis,
W89-00465 5E

Microbial Characterization of Municipal Wastewater at a Spray Irrigation Site: the Lubbock Infection Surveillance Study,
W89-01124 7B

Assessing Effects of Soil Pollution Control Residuals on Soil Chemistry Properties,
W89-01140 5E

LAND MANAGEMENT

Once and Future Experience of the California Coastal Conservancy,
W89-01067 6E

Wetland Projects of the California State Coastal Conservancy: An Assessment,
W89-01069 6E

Prospects for Transfer of the California Coastal Conservancy Model for Habitat Restoration to Other Coastal States,
W89-01070 6E

Coastal Management Issues for the Mouth of the River Murray, South Australia,
W89-01072 6E

LAND RECLAMATION

Evaluating Peat-Mining Hydrology Using DRAINMOD,
W89-00755 4C

LAND SUBSIDENCE

Cities Supported by Sticks in the Mud: A Variation on the Settlement of Land and Structures Caused by Ground Water Removal,
W89-01190 6E

LAND USE

Evaluating Peat-Mining Hydrology Using DRAINMOD,
W89-00755 4C

Satellite Data and Geographical Information System for Land Use Classification,
W89-00756 7B

Wetland Projects of the California State Coastal Conservancy: An Assessment,
W89-01069 6E

LANDFILLS

Procedure for Evaluating Municipal Solid Waste Leachate Components Capable of Causing Volume Shrinkage in Compacted Clay Soils,
W89-00621 5E

Estimation of the Risk Associated with the Organic Constituents of Hazardous and Municipal Waste Landfill Leachates,
W89-00995 5B

Interaction of Earthen Liner Materials with Industrial Waste Leachate,
W89-00997 5E

Contaminant Hydrogeology Dollars and Sense,
W89-01028 5B

LANDFORMS

Development of Streamlined Bog Islands in the Continental Interior of North America,
W89-00434 2H

LANDSLIDES

Formation and Failure of Natural Dams,
W89-00470 2J

Experience in Determining the Numerical Characteristics of Landslide Movements,
W89-00551 8A

LARVAE

Effect of Low pH on Survival of Brook Trout Embryos and Yolk-Sac Larvae in West Virginia Streams,
W89-00293 5C

Corneal Damage in Larvae of Striped Bass Morone saxatilis Exposed to Copper,
W89-00380 5C

Effects of Cadmium on Early Developmental Stages of the Sheepshead Minnow (Cyprinodon Variegatus),
W89-01091 5C

LARVAL GROWTH STAGE

Dispersal and Recruitment of Fiddler Crab Larvae in the Delaware River Estuary,
W89-01039 2L

LAW OF THE SEA

Toxic and Environmental Torts within Admiralty,
W89-00518 6E

LEACHATES

Procedure for Evaluating Municipal Solid Waste Leachate Components Capable of Causing Volume Shrinkage in Compacted Clay Soils,
W89-00621 5E

Estimation of the Risk Associated with the Organic Constituents of Hazardous and Municipal Waste Landfill Leachates,
W89-00995 5B

Interaction of Earthen Liner Materials with Industrial Waste Leachate,
W89-00997 5E

Anaerobic Treatment of Leachate Using Fixed Film and Sludge Bed Systems,
W89-01238 5D

LEACHING

Concerning Certain Studies on Seepage and Dissolution of Salts in the Foundation of Dams,
W89-00062 10C

Leaching of Retorted Oil Shale: Assessing the Toxicity to Colorado Squawfish, Fathead Minnows, and Two Food-Chain Organisms,
W89-00329 5C

Immobilization of Leachable Toxic Soil Pollutants by Using Oxidative Enzymes,
W89-00341 5G

Modelling of Flow Through Potash Tailings Piles,
W89-00388 5B

Leaching of Mercury from Peat Soil,
W89-00592 5B

Comparison of Drinking Water Mutagenicity with Leaching of Polycyclic Aromatic Hydrocarbons from Water Distribution Pipes,
W89-00619 5C

Effect of pH and Contact Time on the Concentration of As(III) and As(V) in Coal Ash Systems,
W89-00624 5E

Leaching of Inorganic Hazardous Constituents from Stabilized/Solidified Hazardous Wastes,
W89-00999 5E

Effects of Leaching and Whole-Tree Harvesting on Cation Budgets of Several Forests,
W89-01166 4C

Role of Soil Organic Matter in the Geochemical Cycling of Chloride and Bromide,
W89-01200 2A

LEAD

Solubilities of Trace Copper and Lead Species and the Complexing Capacity of River Water in the Linggi River Basin,
W89-00084 5B

Concentrations of Trace Metals in the Qiantagnjiang River and its Estuary in Southern China,
W89-00443 5B

Trends in Lead Concentrations in Major U.S. Rivers and Their Relation to Historical Changes in Gasoline-Lead Consumption,
W89-00868 5B

Toxicity of Alkyllead Salts to Anaerobic Nitrogen Transformations in Sediment,
W89-01167 5C

LEAD RADIOISOTOPES

Chernobyl 134Cs, 137Cs, and 210Pb in High Mountain Lake Sediment: Measurements and Modeling of Mixing Process,
W89-00271 5B

LEAKAGE

Petaling Jaya Non-Revenue Water Control Project Selangor, Malaysia,
W89-00923 5F

LEAVES

Effects of a Simulated Acid Precipitation on Leaf Litter Quality and the Growth of a Detritivore in a Buffered Lotic System,
W89-01058 5C

LEGAL ASPECTS

Citizen Suits under the Clean Water Act: Waiting for Godot in the Fifth Circuit,
W89-00517 6E

LEGAL ASPECTS

Toxic and Environmental Torts within Admiralty,
W89-00518 6E

Hazardous and Noxious Substances,
W89-00519 5G

Sierra Club v. Block, Wilderness Water Rights Protected Where Not in Conflict with Purposes of National Forest in Colorado,
W89-00522 6E

Regulation of Pollution: Controls and Responsibilities,
W89-00786 6E

Marine Pollution in Orkney,
W89-00796 5G

Conservation of Natural Resources,
W89-00827 6E

Survey of the International Law of Rivers,
W89-00835 6E

Politics of Hydro-Megaprojects: Damming with Faint Praise in Australia, New Zealand, and British Columbia,
W89-00836 6E

Clean Air Act-Transboundary Acid Rain Pollution Abatement-Administrative Discretion Citizen Suit,
W89-00839 5G

Look to the Future: Environmental Education,
W89-01121 5G

Cities Supported by Sticks in the Mud: A Variation on the Settlement of Land and Structures Caused by Ground Water Removal,
W89-01190 6E

Drafting Purchase and Sale Agreements Affecting Water Rights,
W89-01252 6E

Drafting Water Quality Agreements,
W89-01253 6E

New Directions in Nebraska Water Policy,
W89-01266 6E

State Equitable Apportionment of Western Water Resources,
W89-01267 6E

Recurring State Judicial Task of Choosing Rules for Groundwater Law: How Occult Still,
W89-01268 6E

LEGIONNAIRE'S DISEASE

Legionnaire's Disease in a Johannesburg Teaching Hospital,
W89-00450 5F

LEGIONNAIRES DISEASE

Epidemiological Study of the Legionella pneumophila Presence in Potable Water in Alicante,
W89-00925 5A

LEGISLATION

River Regulation in the United Kingdom: An Historical Perspective,
W89-00949 4A

Outstanding Problems in River Regulation,
W89-00963 4A

Once and Future Experience of the California Coastal Conservancy,
W89-01067 6E

California Tahoe Conservancy: Applying the Principles,
W89-01068 6E

Wetland Projects of the California State Coastal Conservancy: An Assessment,
W89-01069 6E

LENTIC ENVIRONMENT

Carbon Source of the Water Soldier, Stratiotes aloides L.,
W89-00128 2H

LETOWO LAKE

Sorption Properties of Bottom Sediments of Szczytno Male and Letowo Lakes,
W89-00256 2H

LEUCINE

Estimating Bacterial Production in Marine Waters from the Simultaneous Incorporation of Thymidine and Leucine,
W89-00729 7B

LIDAR

Comparison of High-Altitude Remote Aircraft Measurements with the Radar Structure of an Oklahoma Thunderstorm: Implications for Precipitation Estimation from Space,
W89-00844 7B

LIFE CYCLES

Population Dynamics and Production of Chironomidae (Diptera) at 2 m depth in Lake Esrom, Denmark,
W89-00182 2H

Impact of River Regulations on Invertebrate Communities in the U.K.,
W89-00959 4A

LIFE HISTORY STUDIES

Biomass, Productivity and Life History Traits of Juncus militaris Bigel. in Two Rhode Island (U.S.A.) Freshwater Wetlands,
W89-00100 2H

Some Biological Aspects of Liza abu (Heckel) mugilidae, in AL-Daoodi Drain, (Baghdad, Iraq),
W89-00890 2H

LIGHT INTENSITY

Landsat-MSS Radiance as a Measure of Suspended Sediment in the Lower Yellow River (Hwang Ho),
W89-00065 7B

Particulate Concentrations in Lake St. Clair as Recorded by a Shipborne Multispectral Optical Monitoring System,
W89-00066 7B

Effects of Light Intensity on Growth of Azolla pinnata Cultured in Effluent Collected from the Banka Stream in West Bengal, India,
W89-00127 5C

Effect of Light Regime upon Growth Rate and Chemical Composition of a Clone of Skeletonema costatum from the Trondheimsfjord, Norway,
W89-00212 2L

Vertical Distribution of Phytoplankton in a Stratified Lake (Lago Dom Helvecio, Southeastern Brazil) with Special Reference to the Metalimnion,
W89-00768 2H

LIGHT PENETRATION

Effects of Grazers and Light Penetration on the Survival of Transplants of Vallisneria americana Michx in the Tidal Potomac River, Maryland,
W89-00108 2H

Nutrient and Light Limitation of Algae in Two Northern California Streams,
W89-00296 2H

LIGHT QUALITY

Effects of Light and Temperature on Photosynthesis of the Nuisance Alga Cladophora glomerata (L.) Kutz from Green Bay, Lake Michigan,
W89-00848 2H

LIGNIN

High Molar Mass Lignin in Bleached Kraft Pulp Mill Effluents,
W89-00361 5A

Lignin Residues as Tracers of Organic Waste Transport,
W89-00561 7B

LIME

Properties of Water Treatment Lime Sludges and Their Effectiveness as Agricultural Limestone Substitutes,
W89-00516 5F

LIMESTONE

Properties of Water Treatment Lime Sludges and Their Effectiveness as Agricultural Limestone Substitutes,
W89-00516 5F

LIMITING FACTORS

Relationship between Zooplankton Development and Environmental Conditions in Different Types of Lakes in the Zone of Temperate Climate.
W89-00138 2H

LIMITING NUTRIENTS

Photosynthesis of Submersed Macrophytes in Acidified Lakes: II. Carbon Limitation and Utilization of Benthic CO2 Sources,
W89-00095 5C

Carbon Source of the Water Soldier, Stratiotes aloides L.,
W89-00128 2H

Role of Sewage Effluent in the Accumulation of Macroalgal Mats on Intertidal Mudflats in Two Basins in Southern England,
W89-00159 5C

Clouds, Deep Chlorophyll Maxima and the Nutrient Supply to the Mixed Layer of Stratified Water Bodies,
W89-00227 2L

Habitat Requirements and Bioindicator Value of the Main Communities of Aquatic Vegetation in North-East Poland,
W89-00235 2H

Limnocorral Experiments in a Eutrophic Lake - Effects of Fish on the Planktonic and Chemical Conditions,
W89-00253 2H

LIMNOLGY

Primary Production in the Orinoco River,
W89-00907 2H

LIMNOLOGY

Distribution, Dynamics and Productivity of a Colonizing (Polydora quadrilobata) and an Established (P. ligni) Polydorid Polychaete in Lake Grevelingen: An Enclosed Estuary in the SW Netherlands,
W89-00002 2H

Seasonal and Short-Term Fluctuations in the Zooplankton Community of Paranoa Reservoir, Brasilia, Federal District, Brazil (Flutuacoes Sazonais e de Curta Duracao na Comunidade Zooplanktonica do Lago Paranoa, Brasilia-DF, Brasil),
W89-00006 2H

Decomposition Rates of Allochthonous Material (Litter) in Lake Carioca - Rio Doce Forest Park - MG (Taxa de Decomposicao do Material Aloctone 'Litter' na Lagoa Carioca - Parque Florestal do Rio Doce - Minas Gerias),
W89-00007 2H

Nutrient Release Through Decomposition of Diplodon Delodontus Expansus (Mollusca, Bival-

via) and Some Considerations of its Effects on the Ecology of a Small Tropical Reservoir,
W89-00009 2H

Hypolimnetic Chlorophyll Maximum by Algae and Sulphur Bacteria in one Eutrophic Pond,
W89-00012 2H

Scientific Concepts and Methodologies Pertinent to Lake Research and Lake Restoration,
W89-00013 2H

Background Aspects of Lake Restoration: Water Balance, Heavy Metal Content, Phosphorus Homeostasis,
W89-00014 2H

Lake Restoration: Why Oxygenation and Artificial Mixing Cannot Substitute for a Decrease in the External Phosphorus Loading,
W89-00015 5G

Internal Elemental Cycles Affecting the Long-Term Alkalinity Status of Lakes: Implications for Lake Restoration,
W89-00016 5G

Response of Phytoplankton Communities to Changing Lake Environments,
W89-00018 2H

Food Web Manipulation Without Nutrient Control: A Useful Strategy in Lake Restoration,
W89-00019 5G

Seasonal Productivity Cycle of Phytoplankton and Controlling Factors in Lake Constance,
W89-00022 2H

Origin and Size of Hypolimnic Mixing in Urnersee, the Southern Basin of Vierwaldstattersee (Lake Lucerne),
W89-00023 2H

Drift of Zooplankton in a Lake-Outlet (Glatt) in a Day-Night-Rhythm Depending from the Water Level,
W89-00025 2H

Feedback Dependence Between the Eutrophication Process and Changes in the Fish Community: The Theory of Ichthyoeutrophication (Sprzezenie zwrothe miedzy procesum eutrofizacji a zmianami zespolu ryb. Tesri ichtioeutrofizacji),
W89-00031 5C

Influence of Sediment Composition and Irradiance on the Growth and Morphology of Myriophyllum spicatum L.,
W89-00098 2H

Biomass, Productivity and Life History Traits of Juncus militaris Bigel. in Two Rhode Island (U.S.A.) Freshwater Wetlands,
W89-00100 2H

Sources and Fate of Detritus in the Shore Zone of Lakes,
W89-00121 2H

Lake Enrichment by Submersed Macrophytes: A Norwegian Whole-Lake Experience with Elodea canadensis,
W89-00131 2H

Relationship between Zooplankton Development and Environmental Conditions in Different Types of Lakes in the Zone of Temperate Climate.
W89-00138 2H

Seasonal Fluctuations in the Species Composition of Phytoplankton and Phytobenthos in the Lobau Near Vienna (Jahreszeitliche Schwankungen in der Zusammensetzung des Phytoplanktons und Phytobenthos in Altwassern der Lobau bei Wien),
W89-00166 2H

Quantum Yield as a Fundamental Parameter Controlling Vertical Photosynthetic Profiles of Phytoplankton in Lake Constance,
W89-00176 2H

Community Grazing and the Regulation of In Situ Clearance and Feeding Rates of Planktonic Crustaceans in Lakes in the Kuokkel Area, Northern Sweden,
W89-00181 2H

Benthic Cyanophyte Associations in Streams and Lakes (Benthische Cyanophyten-Gemeinschaften in Bachen und Seen),
W89-00184 2H

Physiological Ecology of Bluegreen Algal Mats (Modern Stromatolites) in Antarctic Oasis Lakes,
W89-00185 2H

Biochemical Models for the Hypolimnetic Oxygen Depletion in Lakes Impacted by Wastewater Discharges: 1. Alternative models,
W89-00186 5C

Factors Affecting Nutrient Dynamics in a Piedmont North Carolina Reservoir,
W89-00187 2H

Dynamics of Iron and Manganese in the Surface Sediments of a Seasonally Anoxic Lake,
W89-00188 2H

Biochemical Models for the Hypolimnetic Oxygen Depletion in Lakes Impacted by Wastewater Discharges: 2. Phytoplankton Biomass Model,
W89-00189 5C

Periphyton Diatom Communities and Trophic States of Three Shallow Lakes in the Pfynwald Region of Canton Valais, Switzerland,
W89-00195 2H

Primary Studies on Population Dynamics of 3 Species of Cladocera (Waterflea) in Dianshan Lake, (in Chinese),
W89-00198 2H

Measurement of Primary Productivity in a High-Rate Oxidation Pond (HROP),
W89-00213 2H

Short-term Dynamics of a Melosira Population in the Plankton of an Impoundment in Central Chile,
W89-00214 2H

Loss Processes Influencing Growth of Planktonic Bacterial Populations in Lake Constance,
W89-00217 2H

Body Size and Mass Flow in Freshwater Plankton: Models and Tests,
W89-00218 2H

Spatial and Temporal Distribution Patterns of Three Trophic Levels in a Saline Lake,
W89-00219 2H

Zooplankton Community Grazing in a Hypertrophic Lake (Hartbeespoort Dam, South Africa),
W89-00220 2H

Summer Dynamics of the Deep Chlorophyll Maximum in Lake Tahoe,
W89-00224 2H

Bacterial Response to Seasonal Changes in Primary Production and Phytoplankton Biomass in Lake Constance,
W89-00225 2H

Regeneration and Uptake of Ammonium by Plankton in an Amazon Floodplain Lake,
W89-00230 2H

Role of Storms in the Summer Succession of the Phytoplankton Community in a Shallow Lake (Lake Balaton, Hungary),
W89-00232 2H

Sedimentation of Phytoplankton Populations Dominated by Microcystis in a Shallow Lake,
W89-00233 2H

Habitat Requirements and Bioindicator Value of the Main Communities of Aquatic Vegetation in North-East Poland,
W89-00235 2H

Chemical Characteristics of Bottom Sediment Top Layer in Szczytno Male Lake,
W89-00237 2H

Primary Production in Lakes with Cage Trout Culture,
W89-00238 2H

Sorption of Cations by Bottom Sediments of Szczytno Male and Letowo Lakes, with Cage Trout Culture,
W89-00239 2H

Nitrogen and Phosphorus Balance in Lake Szczytno Male,
W89-00240 2H

Hydrochemical Study of Lake Szczytno Male With Trout Cage Culture,
W89-00241 5B

Thermal Ecology of Surinsar, a Subtropical Freshwater Lake in Jammu, India,
W89-00242 2H

Concentrations of Nitrogen and Phosphorus in Waters of Two Hypertrophic Lakes and Their Effect on the Quantity of Phytoplankton Biomass,
W89-00245 2H

Diurnal Fluctuations of Phosphorus Forms in Lake Water and Seston in Pluss-See,
W89-00246 2H

Effect of Witobelskie and Lodzko-Dymaczewskie Lakes on Phytoplankton of Samica Steszewska River,
W89-00247 2H

Estimation of Phytoplankton Biomass and Production, and Organic Matter Decomposition in Three Small Field-Ponds,
W89-00252 2H

Limnocorral Experiments in a Eutrophic Lake - Effects of Fish on the Planktonic and Chemical Conditions,
W89-00253 2H

Sorption Properties of Bottom Sediments of Szczytno Male and Letowo Lakes,
W89-00256 2H

Changes in Chlorophyll Contents of Swietokrzyskie Lake Phytoplankton, as Related to Qualitative and Quantitative Fluctuations of Phytoplankton Density and of the Physicochemical Conditions in this Lake in Summer 1979,
W89-00257 5C

Qualitative and Quantitative Changes in Phytoplankton on the Background of Physicochemical Changes in the Water of Swietokrzyskie Lake in the Years 1977-1979,
W89-00258 5C

Differentiation of the Physical and Chemical Properties of Bottom Sediments in Phytocenoses

of Myriophylletum verticillati Soo 1927, Potamogetonetum natantis Soo 1927 and Hydrocharitetum morsus-ranae Langendonck 1935 Associations,
W89-00259 2H

Chlorophyll Relationships in Letowo and Szczytno Male Lakes, with Trout Cage Culture,
W89-00262 2H

Typha Productivity in a Texas Pond: Implications for Energy and Nutrient Dynamics in Freshwater Wetlands,
W89-00524 2H

Structure of a Population of Lobelia dortmanna L. Along a Gradient of Increasing Depth in an Oligotrophic Lake,
W89-00525 2H

Seasonal Development of Lobelia Dortmanna L. and Annual Balance of Its Population Size in an Oligotrophic Lake,
W89-00526 2H

Demographic Study of Aerial Shoots of Carex rostrata in Relation to Water Level,
W89-00530 2H

Analysis and Assessment of Water Quantities in Lakes of China, (In Chinese),
W89-00531 2H

Hydrological Features of Poyang Lake, (in Chinese),
W89-00532 2H

Hydrological Features of Poyang Lake (II), (in Chinese),
W89-00535 2H

Effects of Current Velocity on the Physical Structuring of Diatom (Bacillariophyceae) Communities,
W89-00686 2E

Degradation and Formation of Refractory DOM by Bacteria During Simultaneous Growth on Labile Substrates and Persistent Lake Water Constituents,
W89-00691 2H

Dynamics of Hydra Populations in Lake Zurich, Switzerland, and Lake Maggiore, Italy,
W89-00692 2H

Seasonal Changes of the Profundal Macrobenthic Community in a Polluted Lake,
W89-00693 5C

Comparison of Robust Bayes and Classical Estimators for Regional Lake Models of Fish Response to Acidification,
W89-00713 5C

Vertical Distribution of Phytoplankton in a Stratified Lake (Lago Dom Helvecio, Southeastern Brazil) with Special Reference to the Metalimnion,
W89-00768 2H

Nitrogen Metabolism in the Brackish Lake Nakanoumi. III. Nitrification-Dentrification in Low Concentration of Dissolved Oxygen, (in Japanese),
W89-00769 2H

Seasonal Change of Iron and Manganese in Lake Fukami-ike: Occurrence of Turbid Manganese Layer,
W89-00770 2H

Dissolved Organic Carbon and Manganese in the Boundary of the Oxic and Anoxic Layers in Lakes Fukami-ike and Suigetsu-ko,
W89-00771 2H

Studies on Formations and Changes of Micro-Stratification in Blackish Water Lake Shinji, (in Japanese),
W89-00772 2H

Utilization of Nitrogenous Nutrients by Natural Phytoplankton in Enriched Lake Waters,
W89-00773 2H

Distribution of Cadmium in Lake Tohya,
W89-00774 2H

Effects of Light and Temperature on Photosynthesis of the Nuisance Alga Cladophora glomerata (L.) Kutz from Green Bay, Lake Michigan,
W89-00848 2H

Fish, Fleas and Phytoplankton,
W89-00851 5C

Tropical Eutrophic Lake Modeling and Parameter Discrimination,
W89-00872 2H

Seasonal Phytoplankton Demographic Processes and Experiments on Interspecific Competition,
W89-00906 2H

Manganese Oxidation in pH and O2 Microenvironments Produced by Phytoplankton,
W89-01045 2K

Spatial Patchiness in the Lacustrine Sedimentary Environment,
W89-01048 2H

Size Structure of Planktonic Crustaceans in a Dimictic Lake on the Canadian Shield (Structure en Taille des Crustaces Planctoniques d'un Lac Dimictique du Bouclier Canadien),
W89-01231 2H

Sampling Strategies and Associated Errors in Estimating Epilimnetic Chlorophyll in Eutrophic Lakes,
W89-01242 2H

LININGS

Procedure for Evaluating Municipal Solid Waste Leachate Components Capable of Causing Volume Shrinkage in Compacted Clay Soils,
W89-00621 5E

Interaction of Earthen Liner Materials with Industrial Waste Leachate,
W89-00997 5E

LIQUID CHROMATOGRAPHY

Determination of Hydrophilic Thiols in Sediment Porewater Using Ion-Pair Liquid Chromatography Coupled to Electrochemical Detection,
W89-00266 7B

Speciation Studies of Copper and Magnesium in Duckweed Extract Using Interfaced HPLC and Thermospray Neubulizer Flame AA,
W89-00886 5D

LITERATURE REVIEW

Concerning Certain Studies on Seepage and Dissolution of Salts in the Foundation of Dams,
W89-00062 10C

Formation and Failure of Natural Dams,
W89-00470 2J

Groundwater Recharge in Arid Regions: Review and Critique of Estimation Methods,
W89-00914 2F

Prospects for Transfer of the California Coastal Conservancy Model for Habitat Restoration to Other Coastal States,
W89-01070 6E

Review of the Use of XAD Resins to Concentrate Organic Compounds in Water,
W89-01215 5A

LITERATURE REVIEWS

Hydrocarbon Fuel Spill Dispersion on Water: A Literature Review,
W89-00598 5B

Modelling Soil Water Dynamics in the Unsaturated Zone: State of the Art,
W89-01014 2G

Erosion and Sediment Yield Research: Some Recent Perspectives,
W89-01015 2J

Tracing of Water Movement in the Unsaturated Zone Using Stable Isotopes of Hydrogen and Oxygen,
W89-01016 2G

Alluvial Channel Hydraulics,
W89-01017 2J

Status of Isotope Hydrology Today,
W89-01018 2A

Remote Sensing in Hydrology,
W89-01019 2A

Methods and Merits of Regional Flood Frequency Analysis,
W89-01020 2E

Spatial and Temporal Scales in Rainfall Analysis Some Aspects and Future Perspectives,
W89-01021 2B

Hillslope Runoff Processes and Models,
W89-01022 2A

Rainfall-Runoff Modeling: Past, Present and Future,
W89-01023 2A

Hydrological Heterogeneity Catchment Morphology and Catchment Response,
W89-01024 2A

Soil Physics and Hydrology,
W89-01026 2G

Transport of Solutes in Soils and Aquifers,
W89-01027 5B

Contaminant Hydrogeology Dollars and Sense,
W89-01028 5B

LITTER

Decomposition Rates of Allochthonous Material (Litter) in Lake Carioca - Rio Doce Forest Park - MG (Taxa de Decomposicao do Material Aloctone 'Litter' na Lagoa Carioca - Parque Florestal do Rio Doce - Minas Gerias),
W89-00007 2H

Effects of a Simulated Acid Precipitation on Leaf Litter Quality and the Growth of a Detritivore in a Buffered Lotic System,
W89-01058 5C

LITTLE MIAMI RIVER

Impact of a Municipal Wastewater Effluent on Water Quality, Periphyton, and Invertebrates in the Little Miami River Near Xenia, Ohio,
W89-00685 5C

LITTORAL ENVIRONMENT

Sources and Fate of Detritus in the Shore Zone of Lakes,
W89-00121 2H

LIVER

Biochemical Changes in the Liver of Fish, Tilapia mossambica (Peters), during Continuous Exposure to Monocrotophos,
W89-00085 5C

LOCKS
Reliability and Safety Inspection of Hydraulic Structures of the Moscow Canal,
W89-00051 8A

Improvement of the Electrical Equipment and Control Systems to the Lock Mechanisms of the Moscow Canal,
W89-00052 8C

LODZKO-DYMACZEWSKIE LAKE
Effect of Witobelskie and Lodzko-Dymaczewskie Lakes on Phytoplankton of Samica Steszewska River,
W89-00247 2H

LOGGING
Reduction of a Dolly Varden Population and Macrobenthos after Removal of Logging Debris,
W89-00322 4C

Effect of Logging and Regeneration on Groundwater, Streamflow and Stream Salinity in the Southern Forest of Western Australia,
W89-00350 4C

LOISACH RIVER
Structure of Macrobenthic Biomass in the Gravel Bed of the Pre-Alpine Loisach River (Die Struktur der makrobenthischen Biomasse in einem voralpinen Schotterbett am Beispiel der mittleren Loisach),
W89-00167 2H

LONDON
London Water Ring Main,
W89-00840 5F

LONG-TERM PLANNING
Setting the Water Quality Agenda: 1988 and Beyond,
W89-00505 5G

LONGSHORE CURRENTS
Measurement of Shallow Water Wave Direction for Longshore Sediment Transport,
W89-01082 2J

LOS ANGELES
Contaminant Concentrations and Toxicity of Sea-Surface Microlayer Near Los Angeles, California,
W89-00857 5C

LOTIC ENVIRONMENT
Effects of Stream Cleaning on Juvenile Coho Salmon and Dolly Varden in Southeast Alaska,
W89-00374 2H

Effects of a Simulated Acid Precipitation on Leaf Litter Quality and the Growth of a Detritivore in a Buffered Lotic System,
W89-01058 5C

LOUISIANA
Spartina alterniflora Die-Back in Louisiana: Time-Course Investigation of Soil Waterlogging Effects,
W89-00286 2H

Contributions of Heavy Metals from Municipal Runoff to the Sediments of Lake Pontchartrain, Louisiana,
W89-00618 5B

Marsh Management Plans in Practice: Do They Work in Coastal Louisiana, USA,
W89-01060 2L

LOW FLOW
Derivation of Baseflow Recession Constant Using Computer and Numerical Analysis,
W89-01142 2E

LYSIMETERS
Determination of Water Use Efficiency of Veld in the Central Orange Free State from Evapotranspiration Measurements (Bepaling van Waterverbruiksdoeltreffendheid van Veld in die Sentrale Oranje-Vrystaat Vanaf Evapotranspirasiemetings),
W89-00934 2D

MACROHYDROLOGY
Macrohydrology: The New Challenge for Process Hydrology,
W89-01012 2A

MACROINVERTEBRATES
Distribution, Dynamics and Productivity of a Colonizing (Polydora quadrilobata) and an Established (P. ligni) Polydorid Polychaete in Lake Grevelingen: An Enclosed Estuary in the SW Netherlands,
W89-00002 2H

Baseline Study of Jordan Creek, City of Allentown, Lehigh County, Pennsylvania,
W89-00313 5C

Periphyton, Benthic Invertebrates and Fishes as Biological Indicators of Water Quality in the East Branch Brandywine Creek,
W89-00314 5A

Macroinvertebrate Populations in a Thermally Impacted Reservoir,
W89-00397 5C

Macrobenthos of the Beatrice Oilfield, Moray Firth, Scotland,
W89-00782 2L

Sub-Littoral Fauna of the Inverness, Cromarty and Dornoch Firths,
W89-00784 2L

Bioturbation, Microbial Activity and Sediment Properties in an Estuarine Ecosystem,
W89-00806 2L

MACROPHYTES
Effects of Fish Nests on Pattern and Zonation of Submersed Macrophytes in a Softwater Lake,
W89-00092 2H

Biomass Production and Nutrient Cycling in Aquatic Macrophyte Communities of the Chowan River, North Carolina,
W89-00097 2H

Growth Strategies and Distribution of Isoetids in Scottish Freshwater Lochs,
W89-00129 5C

Scanning Electron Microscopy of Bacteria and Diatoms Attached to a Submerged Macrophyte in an Increasingly Polluted Stream,
W89-00132 5C

Oxygen Budget of a River in Submerged Macrophytes (River Zschopau in the South of the GDR),
W89-00137 2H

Diel and Seasonal Carbon Budgets in Two Cold Spring Ecosystems,
W89-00177 2H

Ecological Role of the Red-Knobbed Coot, Fulica cristata Gmelin, at the Bot River Estuary, South Africa: A Preliminary Investigation,
W89-00662 2L

Ecology of Freshwater Gastropods in the Central Canadian Region,
W89-01183 2H

MACROPORES
Intrapedal Macropore Distribution and Infiltration Rate of Three Friona Polypedons,
W89-00408 2G

MADERA RIVER
Water Resources, Salinity and Salt Yields of the Rivers of the Bolivian Amazon,
W89-01213 2E

MAGNESIUM
Speciation Studies of Copper and Magnesium in Duckweed Extract Using Interfaced HPLC and Thermospray Neubulizer Flame AA,
W89-00886 5D

MAHURY ESTUARY
Suspended Matter and Bottom Deposits in the Mahury Estuarine System (French Guiana): Environmental Consequences,
W89-00003 2J

MAINTENANCE
Set of Documents for Overhauling RO400-960-11 Turbines of the Inguri Hydroelectric Station,
W89-00060 8C

MAINTENANCE COSTS
O and M Spending Levels in Third World Irrigation Systems: Exploring Economic Alternatives,
W89-00874 3F

MALA PANEW RIVER
Chemical Mechanisms of Heavy Metal Transport in Waters of Mala Panew and Brynica Rivers (Silesia, Poland),
W89-00251 5B

MALAYSIA
Petaling Jaya Non-Revenue Water Control Project Selangor, Malaysia,
W89-00923 5F

MANAGEMENT PLANNING
Strategies of Lake Sanitation,
W89-00017 5G

Sea Use Planning in Norwegian Waters: National and International Dimensions,
W89-00289 6E

Assessing Networked Coastal Zone Management Programs,
W89-00290 6B

Issues in Rule Base Development,
W89-00305 6A

Improving Water Supply in Thailand,
W89-00422 5F

Twinning: Utility Pairing,
W89-00424 5F

Rating System for a Utility Rehabilitation Program,
W89-00467 6A

Funding Reserve Capacity in Wastewater Systems,
W89-00506 5D

Developer Financing of Public Wastewater Service Infrastructure,
W89-00507 5D

Coastal Planning in the Moray Firth,
W89-00777 2L

Pollution Control and Environmental Planning for the Beatrice Oilfield and Nigg Oil Terminal,
W89-00788 5G

Technology, Institutions, and Social Goals,
W89-00871 6D

Identifying Critical Issues in Recreation Planning and Management: Improving the Management-Research Partnership,
W89-00873 6A

MANAGEMENT PLANNING

Planning Indiana's Water Infrastructure from a Competitive Perspective,
W89-00880 6B

Marsh Management Plans in Practice: Do They Work in Coastal Louisiana, USA,
W89-01060 2L

SDWA Amendments: Small Community Compliance,
W89-01112 6E

Analytical Simulation of Water System Capacity Reliability: 1. Modified Frequency-Duration Analysis,
W89-01240 5F

Analytical Simulation of Water System Capacity Reliability: 2. A Markov Chain Approach and Verification of the Models,
W89-01241 5F

MANANGEMENT PLANNING

Application of Principal Component Analysis to Long-Term Reservoir Management,
W89-00698 6A

MANGANESE

Dynamics of Iron and Manganese in the Surface Sediments of a Seasonally Anoxic Lake,
W89-00188 2H

Impact of Manganese Intoxication on the Blood Pyruvic Acid of a Freshwater Tropical Perch Colisa fasciatus,
W89-00263 5A

Microbially Mediated Mn(II) Oxidation in an Oligotrophic Arctic Lake,
W89-00335 2H

Seasonal Change of Iron and Manganese in Lake Fukami-ike: Occurrence of Turbid Manganese Layer,
W89-00770 2H

Dissolved Organic Carbon and Manganese in the Boundary of the Oxic and Anoxic Layers in Lakes Fukami-ike and Suigetsu-ko,
W89-00771 2H

Microporous Filters with Oxidizing Power for Iron and Manganese Removal from Water,
W89-00889 5F

Manganese Oxidation in pH and O2 Microenvironments Produced by Phytoplankton,
W89-01045 2K

Possible Mechanism for Manganese Phytotoxicity in Hawaii Soils Amended with a Low-Manganese Sewage Sludge,
W89-01169 5E

MANGROVE SWAMPS

Effect of Mangrove Humic-Like Substances on Biodegradation Rate of Detritus,
W89-00476 2L

MANURE

Effects of Polyculture and Manure Fertilization on Water Quality and Heterotrophic Productivity in Macrobrachium rosenbergii Ponds,
W89-00327 8I

Frequent and Important Consequences from Increased Amounts of Liquid Manure (Haeufige und Wichtige Folgen Vermehrten Guelleanfalls),
W89-00500 5B

MAP ANALYSIS

Use of Map Analysis to Elucidate Flooding in an Australian Riparian River Red Gum Forest,
W89-00722 2E

MAP3S NETWORK

Acidic Deposition Distribution and Episode Statistics from the MAP3S Network Database,
W89-01151 5B

MAPPING

System for Coastal Description and Classification,
W89-01071 7C

MARINE ALGAE

Use of Factorial Experimental Design to Evaluate How Biotic and Abiotic Factors Influence Cadmium Accumulation in the Unicellular Alga Dunaliella bioculata,
W89-01043 5B

MARINE ANIMALS

Microbial-Meiofaunal Interrelationships in Some Tropical Intertidal Sediments,
W89-00766 2L

MARINE BACTERIA

Estimating Bacterial Production in Marine Waters from the Simultaneous Incorporation of Thymidine and Leucine,
W89-00729 7B

Clearance of Bacteria-Sized Particles by Natural Populations of Nanoplankton in the Chesapeake Bay Outflow Plume,
W89-01032 2L

MARINE BIOLOGY

K-Systems Analysis for Determining the Factors Influencing Benthic Microfloral Productivity in a Louisiana Estuary, USA,
W89-01035 2L

Influence of Microphytobenthos on the Nutrient Flux between Sediment and Water: A Laboratory Study,
W89-01036 2L

Active Emergence of Meiofauna from Intertidal Sediment,
W89-01037 2L

Dispersal and Recruitment of Fiddler Crab Larvae in the Delaware River Estuary,
W89-01039 2L

Pelagic Ecosystem Model Simulating Production and Sedimentation of Biogenic Particles: Role of Salps and Copepods,
W89-01041 2L

MARINE ENVIRONMENT

Toxic and Environmental Torts within Admiralty,
W89-00518 6E

Global Environment: A Proposal to Eliminate Marine Oil Pollution,
W89-00521 5G

Response of Benthic Meiofauna to Nutrient Enrichment of Experimental Marine Ecosystems,
W89-01033 5C

Bacterial Production in Fresh and Saltwater Ecosystems: A Cross-System Overview,
W89-01034 2H

MARINE PLANTS

Model of Zostera marina L. Photosynthesis and Growth: Simulated Effects of Selected Physical-Chemical Variables and Biological Interactions,
W89-00130 2L

Effects of Oil Contamination on Colonization of Marine Periphytic Microflora,
W89-00681 5C

MARINE SEDIMENTS

Effects of Co-Occurring Aromatic Hydrocarbons on Degradation of Individual Polycyclic Aromatic Hydrocarbons in Marine Sediment Slurries,
W89-00339 5B

Physicochemical and Geotechnical Characteristics of Recent Saguenay Fjord Sediments,
W89-00390 2J

Microbial-Meiofaunal Interrelationships in Some Tropical Intertidal Sediments,
W89-00766 2L

Provisional Diagenetic Model for pH in Anoxic Porewaters: Application to the FOAM Site,
W89-00767 2J

Hydrocarbon and Pollutant Levels in the Cromarty Firth,
W89-00791 5B

Degradation of Low-Toxicity Oil-Based Drilling Mud in Benthic Sediments around the Beatrice Oilfield,
W89-00792 5B

MARKOV PROCESS

Analytical Simulation of Water System Capacity Reliability: 2. A Markov Chain Approach and Verification of the Models,
W89-01241 5F

MARSDIEP INLET

Increased Phytoplankton Primary Production in the Marsdiep Area (Western Dutch Wadden Sea),
W89-00674 5C

MARSH PLANTS

Role of Marsh Plants in the Transport of Nutrients as Shown by a Quantitative Model for the Freshwater Section of the Elbe Estuary,
W89-00120 2L

Seed Germination Traits of Annuals and Emergents Recruited during Drawdowns in the Delta Marsh, Manitoba, Canada,
W89-00126 2H

Exchange of Phosphorus between a Euhaline Vegetated Marsh and the Adjacent Tidal Creek,
W89-00283 5B

Experimental Studies on the Resiliency of Floating Typha Mats in a Freshwater Marsh,
W89-00287 2H

Peat Accumulation and the Success of Marsh Plants,
W89-00909 2H

MARSHES

Evapotranspiration of a Willow Carr in Summer,
W89-00125 2D

Seed Germination Traits of Annuals and Emergents Recruited during Drawdowns in the Delta Marsh, Manitoba, Canada,
W89-00126 2H

Experimental Studies on the Resiliency of Floating Typha Mats in a Freshwater Marsh,
W89-00287 2H

Study of Modern Vicissitudes of the Jianghan Lake Group by Using Remote Sensing Techniques,
W89-00542 2H

Marsh Management Plans in Practice: Do They Work in Coastal Louisiana, USA,
W89-01060 2L

MARYLAND

Interjurisdictional Management in Chesapeake Bay Fisheries,
W89-01073 6E

MASS SPECTROMETRY

Isotope Ratio Measurements of Mo, V, Ti, and Zr and the Determination of These Elements in Water Samples with a Thermal Ionization Quadrupole Mass Spectrometer (Isotopenverhaltnismessung von Mo, V, Ti and Zr Sowie Deren Konzentrationsbestimmung in Wassern Mit Einem Thermionen-Quadrupol-Massenspektrometer),
W89-00267 5A

Chromium Trace Determination in Inorganic, Organic and Aqueous Samples with Isotope Dilution Mass Spectrometry (Chromspurenbestimmungen in Anorganischen, Organischen und waBrigen Proben mit der Massenspektrometrischen Isotopenverdunnungsanalyse),
W89-00268 5A

Determination of Nitrate at the Ng/g Level in Antarctic Snow Samples with Ion Chromatography and Isotope Dilution Mass Spectrometry,
W89-00269 5A

Determination of Heavy Metals at the Pg/g Level in Antarctic Snow with DPASV and IDMS,
W89-00270 5A

Negative Thermal Ionization Mass Spectrometry of Selenium: Part 1. Isotope Ratio Measurements and Determinations in Aquatic Systems with the Isotope Dilution Technique (Negative Thermionen-Massenspektrometrie von Selen: Teil 1. Isotopenverhaeltnismessungen sowie Konzentrationsbestimmungen in Aquatischen Systemen mit der Isotopenverduennungsanalyse),
W89-00737 5A

Gas Chromatographic-Mass Spectrometric Investigations on Lipophilic Anthropogenic Substances in Environmental Samples. II: A Splitter for the Simultaneous Detection of Capillary Gas Chromatograms by up to Four Different GC-Detectors,
W89-01086 5A

MASS TRANSFER

Sorption of Hydrophobic Chemicals from Water: A Hypothesis for the Mechanism of the Particle Concentration Effect,
W89-00585 5B

MATERIALS ENGINEERING

Manufacture of Polyethylene Seals for High-head Gates of Hydraulic Structures,
W89-00043 8G

MATERIALS TESTING

Performance of Buried Small Pipes,
W89-00754 8A

MATHEMATICAL ANALYSIS

Calculation of an Arch Dam on the Basis of Solving the Three-dimensional Problem of the Theory of Elasticity and Theory of Shells,
W89-00057 8A

Vertical Variability of Soil Properties in a Small Watershed,
W89-00354 2G

Hydrodynamic-Stiffness Matrix Based on Boundary Elements for Time-Domain Dam-Reservoir-Soil Analysis,
W89-00447 8B

Application of the Principle of Least Sigma to the Chemical Model of Natural Water, (in Chinese),
W89-00537 2H

Calculation of Channel Deformations of Large Earth Canals with Damless Water Intake from Reservoirs,
W89-00553 8A

Analyses of Equations for Free Water Evaporation Estimates,
W89-00705 2D

Methods for Estimating the Critical Shear Stress of Individual Fractions in Mixed-Size Sediment,
W89-00720 2J

Fractal Nature of River Networks,
W89-00975 2E

Analytical Solution for Aquifer Decontamination by Pumping,
W89-00977 5G

Drawdown Interval Analysis: A Method of Determining the Parameters of Shallow Conduit Flow Carbonate Aquifers from Pumping Tests,
W89-00986 2F

Theoretical Analysis of Deviations from Local Equilibrium During Sorbing Solute Transport Through Idealized Stratified Aquifers,
W89-00987 5B

New Approximate Technique for the Hodograph Method in Groundwater Flow and Its Application to Coastal Aquifers,
W89-01243 2F

MATHEMATICAL EQUATIONS

Regularities in the Formation of Curved Channels,
W89-00041 2J

Statistical Considerations Associated with the Use of the Heterotrophic Activity Method for Estimating V sub max and K' for Aquatic Environments,
W89-00280 7C

Infiltration under Ponded Conditions: 2. Infiltration Equations Tested for Parameter Time-Dependence and Predictive Use,
W89-00740 2G

Explicit Solution to Green-Ampt Equation for Nonuniform Soils,
W89-00760 7B

Generalized Rectangular Weir Equations,
W89-00905 8B

MATHEMATICAL MODELS

Influence of Temperature on Microhabitat Choice by Fishes in a California Stream,
W89-00027 2H

Air and Water Flow: I. Horizontal Flow with an Arbitrary Flux Boundary Condition,
W89-00347 2G

Air and Water Flow: II. Gravitational Flow with an Arbitrary Flux Boundary Condition,
W89-00348 2G

Location-Invariant Plotting Positions for PWM Estimation of the Parameters of the GEV Distribution,
W89-00351 2E

Linear Root Water Uptake Model,
W89-00353 2I

Hydrological Features of Poyang Lake (II), (in Chinese),
W89-00535 2H

Estimation of the Reliability of Earth Dams with Consideration of Seismic Loads,
W89-00557 8E

Dispersion in Heterogeneous Porous Media: 1. Local Volume Averaging and Large-Scale Averaging,
W89-00699 5B

Dispersion in Heterogeneous Porous Media: 2. Predictions for Stratified and Two-Dimensional Spatially Periodic Systems,
W89-00700 5B

Multiple Reflection and Attenuation of Time Domain Reflectometry Pulses: Theoretical Considerations of Applications to Soil and Water,
W89-00701 7B

Determination of Electrical Conductivity Using Time Domain Reflectometry: Soil and Water Experiments in Coaxial Lines,
W89-00702 2G

Optimization Model for Screening Multipurpose Reservoir Systems,
W89-00703 6A

Multidimensional Modeling of Cumulative Rainfall: Parameter Estimation and Model Adequacy through a Continuum of Scales,
W89-00706 2B

Groundwater Flow Systems in Mountainous Terrain: 1. Numerical Modeling Technique,
W89-00708 2F

Groundwater Flow Systems in Mountainous Terrain: 2. Controlling Factors,
W89-00709 2F

Distributed Parameter Approach for Evaluating the Accuracy of Groundwater Model Predictions: 1. Theory,
W89-00711 2F

Distributed Parameter Approach for Evaluating the Accuracy of Groundwater Model Predictions: 2. Application to Groundwater Flow,
W89-00712 2F

Comparison of Robust Bayes and Classical Estimators for Regional Lake Models of Fish Response to Acidification,
W89-00713 5C

Three-Dimensional Radial Dispersion in a Variable Velocity Flow Field,
W89-00715 5B

Maximum Likelihood Criterion for Use With Data Collected at Unequal Time Intervals,
W89-00723 2E

Extension of the Fujita Solution to Air and Water Movement in Soils,
W89-00725 2G

Steady Unsaturated Seepage above a Sloping Impermeable Base,
W89-00726 2G

Basic Encoded Model for One-Dimensional Ground Water Systems Incorporating First-Order Degradation Kinetics,
W89-00888 5B

Modelling the Effects of Acid Deposition: Estimation of Long-Term Water Quality Responses in Forested Catchments in Finland,
W89-00894 5B

Groundwater Velocity Magnitude in Radionuclide Transport Calculations,
W89-00903 5B

Comparison of Two Methods for Summarizing Hydraulic Conductivities of a Layered Soil,
W89-00970 2G

Numerical Modeling of Sorption Kinetics of Organic Compounds to Soil and Sediment Particles,
W89-00981 5B

MATHEMATICAL MODELS

Rainfall-Runoff Modeling: Past, Present and Future,
W89-01023 2A

Potential Importance of Spatial and Temporal Heterogeneity in pH, Al, and Ca in Allowing Survival of a Fish Population: A Model Demonstration,
W89-01052 5C

Composite Method for Estimating Annual Actual Evapotranspiration,
W89-01141 2D

Pumping Tests in Nonuniform Aquifers: The Radially Symmetric Case,
W89-01196 2F

Prediction of Snowmelt Rates in a Deciduous Forest,
W89-01203 2C

Extreme-Value Theory Model for Dependent Observations,
W89-01208 7C

Identification of a Multiple Input, Single Output, Linear, Time Invariant Model for Hydrological Forecasting,
W89-01209 7C

Modeling of Tracer Spreading in a Fracture in which the Aperture Decreases with Depth in a Laminar Flow (Modelisation de la Propagation d'un Traceur dans une Fracture qui se Ferme Progressivement en Profondeur dans l'Hypothese d'un Ecoulement Laminaire Parallele),
W89-01214 2F

Activated Sludge Systems with Biomass Particle Support Structures,
W89-01256 5D

MATHEMATICAL STUDIES

Statistical Considerations Associated with the Use of the Heterotrophic Activity Method for Estimating V sub max and K' for Aquatic Environments,
W89-00280 7C

Dempster's Rule of Combination in Soil-Loss Prediction,
W89-00303 2J

Numerical Simulation on Typhoon Surge and Surge Estimation of Huanghe River Estuary Region in Bohai Sea, (in Chinese),
W89-00543 2L

Single-Well Tracing Method for Estimating Regional Advective Velocity in a Confined Aquifer: Theory and Preliminary Laboratory Verification,
W89-00707 2F

Explicit Solution to Green-Ampt Equation for Nonuniform Soils,
W89-00760 7B

Comparison of Two Methods for Summarizing Hydraulic Conductivities of a Layered Soil,
W89-00970 2G

Contaminant Transport in Fractured Porous Media: Steady State Solutions by a Boundary Integral Method,
W89-00982 5B

MAXIMUM FLOW

Flow Capacity of Culverts on Oregon Coast Range Forest Roads,
W89-00878 8B

MEANDERS

Regularities in the Formation of Curved Channels,
W89-00041 2J

MEASURING INSTRUMENTS

Isotope Ratio Measurements of Mo, V, Ti, and Zr and the Determination of These Elements in Water Samples with a Thermal Ionization Quadrupole Mass Spectrometer (Isotopenverhaltnismessung von Mo, V, Ti and Zr Sowie Deren Konzentrationsbestimmung in Wassern Mit Einem Thermionen-Quadrupol-Massenspektrometer),
W89-00267 5A

Chromium Trace Determination in Inorganic, Organic and Aqueous Samples with Isotope Dilution Mass Spectrometry (Chromspurenbestimmungen in Anorganischen, Organischen und wa-Brigen Proben mit der Massenspektrometrischen Isotopenverdunnungsanalyse),
W89-00268 5A

Determination of Heavy Metals at the Pg/g Level in Antarctic Snow with DPASV and IDMS,
W89-00270 5A

Benthic Chamber for Use in Rivers: Testing against Oxygen Mass Balances,
W89-00488 7B

Apparatus for Assessing Sulfide Generation Rates from Sewer Slimes,
W89-00497 5D

Mobile Flume for Circular Channel,
W89-00757 7B

Rain Measurement by Raingage-Radar Combination: A Geostatistical Approach,
W89-00761 7B

Charge Induced on a Conducting Cylinder by a Point Charge and Its Application to the Measurement of Charge on Precipitation,
W89-00762 7B

Speciation Studies of Copper and Magnesium in Duckweed Extract Using Interfaced HPLC and Thermospray Neubulizer Flame AA,
W89-00886 5D

Simple and Efficient New Design of the Submersible Stirrer for the YSI Dissolved Oxygen Meter,
W89-00936 7B

Gravimetric Measurement of Adsorption Parameters in Water Systems with a Quartz Spring Balance,
W89-01216 5A

MEDIAN LETHAL DOSE

Estimating the Acute Toxicity of Waterborne Chemicals in Trout from Measurements of Median Lethal Dose and the Octanol-Water Partition Coefficient,
W89-01095 5C

MEDITERRANEAN SEA

Long Term Impact of Dissolved Dispersed Petroleum Hydrocarbons (DDPH) in Gulf of Iskenderun,
W89-00567 5B

Association Between Seawater Pollution as Measured by Bacterial Indicators and Morbidity Among Bathers at Mediterranean Bathing Beaches of Israel,
W89-00579 5C

Coordinated Programme for Research and Monitoring of Pollution in the Mediterranean,
W89-00582 5A

Wet-Only Precipitation Study in a Mediterranean Site, Patras, Greece,
W89-01152 2B

MELOSIRA

Short-term Dynamics of a Melosira Population in the Plankton of an Impoundment in Central Chile,
W89-00214 2H

MEMBRANE FILTERS

Evaluation of Disposable Membrane Filter Units for Sorptive Losses and Sample Contamination,
W89-00623 5A

MEMBRANE PROCESSES

Formation of Hydrous Zirconium (IV) Oxide Polyelectrolyte Membranes, I. Poly (itaconic acid) and Poly (acrylic-co-itaconic acid),
W89-01062 3A

Experiments on Seawater Desalination by Membrane Distillation,
W89-01063 3A

Preliminary Plan for Membrane Desalination in China,
W89-01066 3A

Evaluating Various Adsorbents and Membranes for Removing Radium from Groundwater,
W89-01109 5F

MERCURY

Monitoring of Mercury Pollution in Dutch Coastal Waters by Means of the Teleostean Fish Zoarces Viviparus,
W89-00150 5C

Dissolved Mercury Behaviour in the Saint Lawrence Estuary,
W89-00285 5B

Depressed Mercury Levels in Biota from Acid and Metal Stressed Lakes Near Sudbury, Ontario,
W89-00442 5B

Coordinated Programme for Research and Monitoring of Pollution in the Mediterranean,
W89-00582 5A

Leaching of Mercury from Peat Soil,
W89-00592 5B

Mercury Inputs into the Amazon Region, Brazil,
W89-00637 5B

Mercury Pollution in the Estuarine Region around Bombay Island,
W89-00638 5B

Field Measurements of Water-Air Exchange of Mercury in Freshwater Systems,
W89-00640 5A

Organochlorine and Mercury Residues in Wild Mink and Otter: Comparison with Fish,
W89-01093 5B

Mercury in Freshwater Fish and Clams from the Cerro Prieto Geothermal Field of Baja California, Mexico,
W89-01153 5B

MESOSCALE CONVECTION

Evolution and Fine Structure of a Long-Lived Meso-alpha-Scale Convective System in a Baiu Frontal Zone. Part II: Meso-gamma-Scale Characteristics of Precipitation,
W89-00416 2B

MESOTROPHIC LAKES

Effects of Acidification and Phosphorus Addition on Phytoplankton Biomass and Productivity in a Circum-Neutral Mesotrophic Lake Receiving Acid Precipitation,
W89-00179 2H

Factors Affecting Nutrient Dynamics in a Piedmont North Carolina Reservoir,
W89-00187 2H

METABOLISM
Mechanisms of DNA Utilization by Estuarine Microbial Populations,
W89-00340 2L

Ecological Role of the Red-Knobbed Coot, Fulica cristata Gmelin, at the Bot River Estuary, South Africa: A Preliminary Investigation,
W89-00662 2L

Metabolic Processes Involved in Repair of Escherichia coli Cells Damaged by Exposure to Acid Mine Water,
W89-00727 5C

METAL COMPLEXES
Possible Mechanism for Manganese Phytotoxicity in Hawaii Soils Amended with a Low-Manganese Sewage Sludge,
W89-01169 5E

METAL-FINISHING WASTES
Mercury Inputs into the Amazon Region, Brazil,
W89-00637 5B

Copper, Nickel, and Chrome Recovery in a Jobshop to Eliminate Waste Treatment and Sludge Disposal,
W89-00993 5D

Effects of Cyanide and Polyphosphates on Adsorption of Metals from Simulated and Real Mixed-Metal Plating Wastes,
W89-01219 5D

METALLOTHIONEIN
Metallothionein-Like Heavy Metal Binding Protein Levels in Asiatic Clams Are Dependent on the Duration and Mode of Exposure to Cadmium,
W89-01228 5B

METALS
River Ems: Processes Affecting the Behaviour of Metals and Organochlorines during Estuarine Mixing,
W89-00149 5B

Dynamics of Iron and Manganese in the Surface Sediments of a Seasonally Anoxic Lake,
W89-00188 2H

Effects of Acidification on Metal Budgets of Lakes and Catchments,
W89-00207 5C

Sensitivity of Young Striped Bass to Organic and Inorganic Contaminants in Fresh and Saline Waters,
W89-00320 5C

Accumulation of Polycyclic Aromatic Hydrocarbons in Acid Sensitive Lakes,
W89-01074 5B

Nitrilotriacetic Acid (NTA) Environmental Monitoring Program in Indiana: 1979 to 1983,
W89-01089 5A

METEOROLOGICAL DATA COLLECTION
Texas Drought History Reconstructed and Analyzed from 1698 to 1980,
W89-00273 2B

El Nino-Southern Oscillation and Rainfall Variability,
W89-00276 2B

Rain Measurement by Raingage-Radar Combination: A Geostatistical Approach,
W89-00761 7B

Climate of the Estuary and Firth of Clyde,
W89-00800 2L

Comparison of High-Altitude Remote Aircraft Measurements with the Radar Structure of an Oklahoma Thunderstorm: Implications for Precipitation Estimation from Space,
W89-00844 7B

Southwest Branch of the North American Monsoon During Summer 1979,
W89-00845 2A

Interannual Variability in Climate and Fisheries in Tasmania,
W89-00847 2A

METEOROLOGICAL DATA COLLECTIONS
Influence of an Arctic Large-Lakes System on Mesoclimate in South-Central Baffin Island, N.W.T., Canada,
W89-00437 2H

METEOROLOGY
Meteorologically Induced Flushing in Three U.S. East Coast Estuaries,
W89-00281 2L

Summer of 1987 in North-East England,
W89-00463 2B

METEROLOGICAL
Experimental Marvin Windshield Effects on Precipitation Records in Leadville, Colorado,
W89-00876 7B

METHANE BACTERIA
Kinetics and Reaction Engineering of Anaerobic Sewage Treatment (Kinetik und Reaktionstechnik der anaeroben Abwasserreinigung),
W89-01185 5D

METHOXY ETHYL MERCURIC CHLORIDE
Branchial and Renal Pathology in the Fish Exposed Chronically to Methoxy Ethyl Mercuric Chloride,
W89-01156 5C

METHYLMERCURY
Effects of Acidification on Mercury Methylation, Demethylation, and Volatilization in Sediments from an Acid-Susceptible Lake,
W89-00731 5B

MEXICO
Multicriterion Selection of Wastewater Management Alternatives,
W89-00300 5D

Southwest Branch of the North American Monsoon During Summer 1979,
W89-00845 2A

Mercury in Freshwater Fish and Clams from the Cerro Prieto Geothermal Field of Baja California, Mexico,
W89-01153 5B

MICHIGAN
Comparison of Three Sediment Bioassay Methods Using Detroit River Sediments,
W89-01097 5A

MICROBIAL DEGRADATION
Bacterial Degradation of Crude Oil Water Pollutants in Danube Water (Die bakterielle Degradation von Erdolkohlenwasserstoffen im Donauwasser),
W89-00168 5B

Microbially Mediated Mn(II) Oxidation in an Oligotrophic Arctic Lake,
W89-00335 2H

Effects of Co-Occurring Aromatic Hydrocarbons on Degradation of Individual Polycyclic Aromatic Hydrocarbons in Marine Sediment Slurries,
W89-00339 5B

Mechanisms of DNA Utilization by Estuarine Microbial Populations,
W89-00340 2L

Microbial Degradation of Xenobiotic, Aromatic Pollutants in Humic Water,
W89-00344 5B

Environmental Fate of Chloroguaiacols and Chlorocatechols,
W89-00369 5B

Influence of Feeding Procedure on Microbial Reductions and Performance of Anaerobic Digestion,
W89-00511 5D

Studies on the Degradation of Synthetic Detergents by Sewage,
W89-01159 5B

MICROBIOLOGICAL STUDIES
Development of Microorganisms on the Background of Organic Matter in Forest Ecosystem Waters,
W89-00080 2H

Microbiological Examination of the Carska Bara Swamp Water,
W89-00146 2H

Statistical Considerations Associated with the Use of the Heterotrophic Activity Method for Estimating V sub max and K' for Aquatic Environments,
W89-00280 7C

Microbial Biomass, Activity, and Community Structure of Water and Particulates Retrieved by Backflow from a Waterflood Injection Well,
W89-00334 5B

Photoexcretion and Fate of Glycolate in a Hot Spring Cyanobacterial Mat,
W89-00342 2H

Microbial Pollution of Well Water in Southeastern Minnesota,
W89-00887 5B

Activity Assessment in Drinking Water Bacteriology - A Comparison of Methods and Possibilities,
W89-00928 5A

Determination of Microbial Kinetic Coefficients through Measurement of Initial Rates by Radiochemical Techniques,
W89-01218 5D

MICROCLIMATOLOGY
Evaporation from Mackenzie Delta Lakes, N.W.T., Canada,
W89-00438 2D

MICROCOSMS
Model Ecosystems as a Tool in Freshwater and Marine Research,
W89-00180 5B

MICROCYSTIS
Sedimentation of Phytoplankton Populations Dominated by Microcystis in a Shallow Lake,
W89-00233 2H

MICROMETEOROLOGY
Aerosol and Hydrometeor Concentrations and Their Chemical Composition during Winter Precipitation along a Mountain Slope: I. Temporal Evolution of the Aerosol, Microphysical and Meteorological Conditions,
W89-01150 2B

MICRONUTRIENTS
Use of Plant Micro-Nutrient and Chlorophyll Records as Indices of Eutrophication in Inshore Waters,
W89-00160 5A

MICROORGANISMS
Body Size and Mass Flow in Freshwater Plankton: Models and Tests,
W89-00218 2H

Microbial Biomass, Activity, and Community Structure of Water and Particulates Retrieved by Backflow from a Waterflood Injection Well,
W89-00334 5B

Pioneer Colonization and Interaction of Photosynthetic and Heterotrophic Microorganisms on an Artificial Substrate of Polyurethane Foam in E. J. Beck Lake, Illinois,
W89-00398 2H

Microbial-Meiofaunal Interrelationships in Some Tropical Intertidal Sediments,
W89-00766 2L

MICROPONDS
Testing the Secondary Treatment of Effluents from the 'Police' Chemical Plant in Carp Ponds,
W89-00255 5D

MICROSCOPIC ANALYSIS
Wound Fiberglass Depth Filters as a Less Expensive Approach for the Concentration of Viruses from Water,
W89-00279 5A

MICROTHRIX
Effect of Environmental Conditions on the Occurrence of Microthrix parvicella in Activated Sludge,
W89-01217 5D

MICROWAVES
Estimation of Bare Soil Evaporation from Airborne Measurements,
W89-00352 7B

MIDGES
Pesticidal Effects on Chironomid Larvae,
W89-00079 5C

Population Dynamics and Production of Chironomidae (Diptera) at 2 m depth in Lake Esrom, Denmark,
W89-00182 2H

Effect of pH and Total Ion Concentration on Growth Rate of Chironomus nr. maturus Larvae (Diptera: Chironomidae) from an Acid Strip-Mine Lake,
W89-00399 5C

MIGRATION
Active Emergence of Meiofauna from Intertidal Sediment,
W89-01037 2L

Dispersal and Recruitment of Fiddler Crab Larvae in the Delaware River Estuary,
W89-01039 2L

MINE DRAINAGE
Evaluating Peat-Mining Hydrology Using DRAINMOD,
W89-00755 4C

MINE WASTES
Modelling of Flow Through Potash Tailings Piles,
W89-00388 5B

Heavy Metal Pollution in the Guadiamar River and the Guadalquivir Estuary (South West Spain),
W89-00573 5B

MINERAL INDUSTRY
Mercury Inputs into the Amazon Region, Brazil,
W89-00637 5B

MINERALIZATION
Nitrogen Dynamics in Lower Narragansett Bay: II. Phytoplankton Uptake, Depletion Rates of Nitrogenous Nutrient Pools, and Estimates of Ecosystem Remineralization,
W89-00215 2L

Effects of Co-Occurring Aromatic Hydrocarbons on Degradation of Individual Polycyclic Aromatic Hydrocarbons in Marine Sediment Slurries,
W89-00339 5B

MINERALS
Iron Oxide Formation in Artificial Ground Waters,
W89-00687 2F

Sediments in the Estuarine Environment of the Tigris/Euphrates Delta; Iraq; Arabian Gulf,
W89-01083 2L

MINK
Organochlorine and Mercury Residues in Wild Mink and Otter: Comparison with Fish,
W89-01093 5B

MINNESOTA
Decomposition in an Ombrotrophic Bog and a Minerotrophic Fen in Minnesota,
W89-00742 2H

Microbial Pollution of Well Water in Southeastern Minnesota,
W89-00887 5B

MISSISSIPPI RIVER
Dynamic Changes and Processes in the Mississippi River Delta,
W89-00469 2J

Variability of Dissolved Trace Metals in the Mississippi River,
W89-01075 5B

MIST
Fog Drip as a Source of Groundwater Recharge in Northern Kenya,
W89-00984 2F

MITIGATION
Hurricane-Related Morphodynamics and Implications for Hazard Mitigation, Perdido Key, Florida, U.S.A.,
W89-00291 6B

MIXING
Mixing of Temperature-Stratified Lakes and Reservoirs by Buoyant Jets,
W89-00492 5G

Micromixing and Dispersion in Chlorine Contact Chambers,
W89-00622 5D

Intercomparison of Four Mixed Layer Models in a Shallow Inland Sea,
W89-00831 2H

Satellite Observations of Tidal Upwelling and Mixing in the St. Lawrence Estuary,
W89-00834 2L

Thermal Simulation of a Lake with Winter Ice Cover,
W89-01044 2H

Use of Hydrogeochemical Sampling Data in Hydraulic Engineering,
W89-01178 2F

MIXOTROPHS
Phagotrophic Phototrophs: The Ecological Significance of Mixotrophy,
W89-00384 2H

MODEL STUDIES
Eutrophication Effects of Prey Size and Food Available to Yellow Perch in Lake Erie,
W89-00030 5C

Certain Characteristics of Calculating Angular Retaining Walls,
W89-00076 8A

Model of Zostera marina L. Photosynthesis and Growth: Simulated Effects of Selected Physical-Chemical Variables and Biological Interactions,
W89-00130 2L

Heat Balance of a Tidal Flat Area,
W89-00148 2L

Model Ecosystems as a Tool in Freshwater and Marine Research,
W89-00180 5B

Biochemical Models for the Hypolimnetic Oxygen Depletion in Lakes Impacted by Wastewater Discharges: 1. Alternative models,
W89-00186 5C

Biochemical Models for the Hypolimnetic Oxygen Depletion in Lakes Impacted by Wastewater Discharges: 2. Phytoplankton Biomass Model,
W89-00189 5C

Body Size and Mass Flow in Freshwater Plankton: Models and Tests,
W89-00218 2H

Texas Drought History Reconstructed and Analyzed from 1698 to 1980,
W89-00273 2B

Statistical Considerations Associated with the Use of the Heterotrophic Activity Method for Estimating V sub max and K' for Aquatic Environments,
W89-00280 7C

Habitat Suitability and Fish Production: A Model Evaluation for Rock Bass in Two Virginia Streams,
W89-00294 2H

Urban Runoff Simulation Model,
W89-00301 2E

Testing a Comprehensive Acid Deposition Model,
W89-00310 5B

Application of Ecological Modelling: Impact of Thermal Effluent on a Smallmouth Bass Population,
W89-00317 5C

Evaluation of the 'Fugacity' (FEQUM) and the 'EXAMS' Chemical Fate and Transport Models: A Case Study on the Pollution of the Norrsundet Bay (Sweden),
W89-00357 5B

Comparisons of RADM and Oscar Precipitation Chemistry Data,
W89-00433 5B

Dynamic Modeling of Primary Sedimentation,
W89-00483 5D

River Basin Water Quality Management in Stochastic Environment,
W89-00490 5G

Numerical Model for the Wind-Driven Circulation in the Bot River Estuary,
W89-00652 2L

Adventures in Holistic Ecosystem Modelling: The Cumberland Basin Ecosystem Model,
W89-00675 2L

Dynamical Structure of Vertically Two-Dimensional Estuary in Steady State,
W89-00680 2L

Distributed Parameter Approach for Evaluating the Accuracy of Groundwater Model Predictions: 1. Theory,
W89-00711 2F

Maximum Likelihood Criterion for Use With Data Collected at Unequal Time Intervals,
W89-00723 2E

Mesoscale Spiral Vortex Embedded within a Lake Michigan Snow Squall Band: High Resolution Satellite Observations and Numerical Model Simulations,
W89-00748 2B

Flow Simulation Using Channel Network Model,
W89-00751 7B

Provisional Diagenetic Model for pH in Anoxic Porewaters: Application to the FOAM Site,
W89-00767 2J

Effluent Disposal and the Physical Environment,
W89-00804 5E

Intercomparison of Four Mixed Layer Models in a Shallow Inland Sea,
W89-00831 2H

Basin Sedimentation and the Growth of Prograding Deltas,
W89-00832 2J

Groundwater Rights: Definition and Transfer,
W89-00838 6E

Model Output Statistics Forecasts: Three Years of Operational Experience in the Netherlands,
W89-00843 2B

Tropical Eutrophic Lake Modeling and Parameter Discrimination,
W89-00872 2H

Developing and Assessing a Model of Residential Water Conservation,
W89-00881 3D

Simulation of Regional Ground Water Flow in Bedrock, Southwestern New York-Northwestern Pennsylvania,
W89-00882 2F

Progress in Developing an Operational Snowmelt-Runoff Forecast Model with Remote Sensing Input,
W89-00891 2A

Modelling the Effects of Acid Deposition: Estimation of Long-Term Water Quality Responses in Forested Catchments in Finland,
W89-00894 5B

Extreme Pressures in Hydraulic-Jump Stilling Basins,
W89-00896 8B

Use of Network Analysis Techniques in the Development and Optimization of a large UK Urban Water Distribution System (L'Emploi de Techniques),
W89-00918 5F

Recreation Resource Allocation Model for Public Drinking Reservoirs,
W89-00921 6D

Optimization of the Production and Pumping Costs of the Nice Water Network (Optimisation de la Production et des Pompages sur le Reseau d'Eau de Nice),
W89-00922 5F

Definition of a Model for Monitoring the Chemical and Chemical-Physical Characteristics of Deep Drinking Waters,
W89-00927 7C

Modeling Contaminant Propagation in Drinking Water Distribution Systems,
W89-00929 5F

STASOFT: A User-Friendly Interactive Computer Program for Softening and Stabilisation of Municipal Waters,
W89-00935 5F

Water Quality Management: A Regional Perspective-The Severn-Trent Area,
W89-00951 5G

River Regulation by Seasonal Groundwater Abstraction: The Case of the River Itchen,
W89-00956 4B

Continuum Models for Contaminant Transport in Fractured Porous Formations,
W89-00966 5B

Multivariate Periodic ARMA (1,1) Processes,
W89-00967 7B

Multisignal Automatic Calibration Methodology for Hydrochemical Models: A Case Study of the Birkenes Model,
W89-00973 5B

Assessing the Birkenes Model of Stream Acidification Using a Multisignal Calibration Methodology,
W89-00974 7B

Assessment of Flood Frequency Models Using Empirical Distribution Function Statistics,
W89-00976 2E

Analytical Solution for Aquifer Decontamination by Pumping,
W89-00977 5G

Management of a Tributary Aquifer,
W89-00978 4B

Gradient Dynamic Programming for Stochastic Optimal Control of Multidimensional Water Resources Systems,
W89-00979 6A

Continuum Approach for Modeling Mass Transport in Fractured Media,
W89-00980 5B

Numerical Modeling of Sorption Kinetics of Organic Compounds to Soil and Sediment Particles,
W89-00981 5B

Simulation Model for Biotransformation of Xenobiotics and Chemotaxis in Soil Columns,
W89-00989 5B

Macrohydrology: The New Challenge for Process Hydrology,
W89-01012 2A

Modelling Soil Water Dynamics in the Unsaturated Zone: State of the Art,
W89-01014 2G

Spatial and Temporal Scales in Rainfall Analysis Some Aspects and Future Perspectives,
W89-01021 2B

Hillslope Runoff Processes and Models,
W89-01022 2A

Rainfall-Runoff Modeling: Past, Present and Future,
W89-01023 2A

Pelagic Ecosystem Model Simulating Production and Sedimentation of Biogenic Particles: Role of Salps and Copepods,
W89-01041 2L

Thermal Simulation of a Lake with Winter Ice Cover,
W89-01044 2H

Composite Method for Estimating Annual Actual Evapotranspiration,
W89-01141 2D

Approximate Confidence Intervals for Verification Criteria of the WMO Intercomparison of Snowmelt Runoff Models,
W89-01143 2E

Problems of Rainfall-Runoff Modelling in Arid and Semiarid Regions,
W89-01144 2E

MODALP: A Deterministic Rainfall-Runoff Model for Large Karstic Areas,
W89-01145 2F

Influence of Altitude on Wet Deposition: Comparison between Field Measurements at Great Dun Fell and the Predictions of a Seeder-Feeder Model,
W89-01147 5B

Stream Acidification Trends in the Welsh Uplands: A Modelling Study of the Llyn Brianne Catchments,
W89-01206 5C

Modeling of Tracer Spreading in a Fracture in which the Aperture Decreases with Depth in a Laminar Flow (Modelisation de la Propagation d'un Traceur dans une Fracture qui se Ferme Progressivement en Profondeur dans l'Hypothese d'un Ecoulement Laminaire Parallele),
W89-01214 2F

Modeling Blue-Green Algal Blooms in the Lower Neuse River,
W89-01225 5C

Transport Modelling of Biological Tracers from Septic Systems,
W89-01226 5B

Waste Allocation Simulation Models,
W89-01234 5D

Lake Response Modeling Using Biologically Available Phosphorus,
W89-01236 5C

Fate and Transport of Organics in Soil: Model Predictions and Experimental Results,
W89-01239 5B

Value of Stochastic Streamflow Models in Overyear Reservoir Design Applications,
W89-01244 2E

Numerical Transport Model for Oxygen- and Nitrate-Based Respiration Linked to Substrate and Nutrient Availability in Porous Media,
W89-01251 5D

Relative Roles of Emissions Changes and Meteorological Variability of Wet sulfur Deposition: A Trajectory Model Study,
W89-01259 5B

Vertically Integrated Snow/Ice Model over Land/Sea for Climate Models: 1. Development,
W89-01260 2C

Vertically Integrated Snow/Ice Model over Land/Sea for Climate Models: 2. Impact on Orbital Change Experiments,
W89-01261 2C

MODEL STUDIES

Comparison of Model-Generated and Satellite-derived Cloud Cover and Radiation Budget,
W89-01262 2A

MODEL TESTING
Linear Root Water Uptake Model,
W89-00353 2I

Evaluation of the 'Fugacity' (FEQUM) and the 'EXAMS' Chemical Fate and Transport Models: A Case Study on the Pollution of the Norrsundet Bay (Sweden),
W89-00357 5B

MODELS STUDIES
Evaluating Peat-Mining Hydrology Using DRAINMOD,
W89-00755 4C

MOISTURE
Predictability of Two Moisture Sources in the Namib Desert,
W89-00455 2B

MOLINATE
Comparison of Laboratory and Field Observations of Fish Exposed to the Herbicides Molinate and Thiobencarb,
W89-00376 5C

MOLLUSCICIDES
Uptake and Distribution of Copper Sulphate and Its Effect on the Respiration Rate of the Hemocyanin-Producing Freshwater Snail Lymnaea natalensis,
W89-01155 5G

MOLLUSKS
Freshwater Mollusks as Indicators of Trophic Conditions in Coastal Lakes of Southern Brazil (Moluscos Dulceaquicolas Como Indicadores de Condicoes Troficas em Lagoas Costeiras do Sul do Brasil),
W89-00008 5A

Unionid (Mollusca:Bivalvia) Fauna of the Shenango River in Mercer County, Pennsylvania,
W89-00312 5C

Long-Term Changes in Some Benthic Species in the Firth of Clyde, with Particular Reference to Tellina tenuis da Costa,
W89-00817 5C

MONITORING
Secondary Ice Nucleus Generation by Silver Iodide Applied to the Ground,
W89-00088 3B

Use of Mires in Monitoring the Atmospheric Deposition of Heavy Metals,
W89-00123 5A

Instrumentation for 7-Day Continuous Cycle Monitoring of Metals with Automated On-Line Sample Preparation, High-Performance Liquid Chromatography, and Electrochemical Detection,
W89-00210 5A

Application and Testing of an Index of Biotic Integrity in Small, Coolwater Streams,
W89-00323 2H

Coordinated Programme for Research and Monitoring of Pollution in the Mediterranean,
W89-00582 5A

Monitoring of PCDDs in Osaka Bay Using Blue Mussel,
W89-00604 5B

Monitoring the Moray Firth Environment,
W89-00787 5C

Sensitivity of Four Monitoring Well Sampling Systems to Low Concentration of Three Volatile Organics,
W89-00944 5A

Method for Locating Wells in a Groundwater Monitoring Network Under Conditions of Uncertainty,
W89-00971 7A

Results of Ecological Monitoring of Three Beaches Polluted by the 'Amoco Cadiz' Oil Spill: Development of Meiofauna from 1978 to 1984,
W89-01031 5C

Micronucleus Test: Examples of Application to Marine Ecology,
W89-01042 5A

Nitrilotriacetic Acid (NTA) Environmental Monitoring Program in Indiana: 1979 to 1983,
W89-01089 5A

Quality Control Approach to NPDES Compliance Determination,
W89-01136 5D

MONITORING WELLS
Screened Auger Sampling: The Technique and Two Case Studies,
W89-00945 5A

Discrete Point Sampler for Ground Water Monitoring Wells,
W89-00947 7B

MONO LAKE
Spatial and Temporal Distribution Patterns of Three Trophic Levels in a Saline Lake,
W89-00219 2H

MONSOONS
Southwest Branch of the North American Monsoon During Summer 1979,
W89-00845 2A

MONTE CARLO METHOD
Load Allocation for Toxics Using Monte Carlo Techniques,
W89-00514 5G

Factors Affecting the Efficiency of Some Estimates of Fluvial Total Phosphorus Load,
W89-01249 5B

MORAY FIRTH
Coastal Topography of the Moray Firth,
W89-00775 2L

Nature Conservation in the Moray Firth,
W89-00776 2L

Coastal Planning in the Moray Firth,
W89-00777 2L

Hydrography and Plankton of the Moray Firth,
W89-00778 2L

Exploited Fish and Shellfish Species in the Moray Firth,
W89-00779 2L

Intertidal Macrofauna of Nigg Bay,
W89-00780 2L

Moray Firth Marine Fouling Communities,
W89-00781 2L

Macrobenthos of the Beatrice Oilfield, Moray Firth, Scotland,
W89-00782 2L

Comparison of the Fauna Retained On 0.5 mm and 1.0 mm Meshes from Benthic Samples Taken in the Beatrice Oilfield, Moray Firth, Scotland,
W89-00783 2L

Sub-Littoral Fauna of the Inverness, Cromarty and Dornoch Firths,
W89-00784 2L

Oil Pollution in the Cromarty Firth and Inshore Moray Firth,
W89-00785 5B

Regulation of Pollution: Controls and Responsibilities,
W89-00786 6E

Monitoring the Moray Firth Environment,
W89-00787 5C

Hydrocarbons in Nigg Bay Sediments,
W89-00790 5B

MORINGA SEED
Using Moringa Seeds as Coagulants in Developing Countries,
W89-00420 5F

MORTALITY
High Rates of Production and Mortality of Submerged Sparganium emersum Rehman during Its Short Growth Season in a Eutrophic Danish Stream,
W89-00099 2H

Mass Mortality of Fish Associated with Low Salinity Conditions in the Bot River Estuary,
W89-00664 2L

MOSCOW CANAL
50th Anniversary of the Moscow Canal,
W89-00049 8A

Water-Management Significance of the Moscow Canal,
W89-00050 3B

Reliability and Safety Inspection of Hydraulic Structures of the Moscow Canal,
W89-00051 8A

Improvement of the Electrical Equipment and Control Systems to the Lock Mechanisms of the Moscow Canal,
W89-00052 8C

Power Facilities of the Moscow Canal,
W89-00053 8C

Hydropower Equipment of the Moscow Canal,
W89-00054 8C

Hydraulic Tests for Reconstructing the Pumping Stations on the Moscow Canal,
W89-00055 8C

MOUNTAIN LAKES
Zooplankton Population of Man-Made Lakes in Abruzzi's Appennines: Campotosto Lake (Popolamento Zooplanctonico di un Lago di Sbarramento Dell'Appennino Abruzzese: Il Lago di Campotosto),
W89-00197 2H

Eutrophication and Benthic Fauna of Three Mountain Lakes (Eutrophisation et Faune Benthique de Trois Lacs de Montagne),
W89-00695 5C

MOUNTAINS
Groundwater Flow Systems in Mountainous Terrain: 1. Numerical Modeling Technique,
W89-00708 2F

Groundwater Flow Systems in Mountainous Terrain: 2. Controlling Factors,
W89-00709 2F

MUD FLATS
Role of Sewage Effluent in the Accumulation of Macroalgal Mats on Intertidal Mudflats in Two Basins in Southern England,
W89-00159 5C

MUDFLOWS
Laboratory Analysis of Mudflow Properties,
W89-00899 2J

MULLET
Comparison of the Physiological Condition of the Southern Mullet Liza richardsoni (Smith), in a Closed Estuary and the Sea,
W89-00663 2L

Some Biological Aspects of Liza abu (Heckel) mugilidae, in AL-Daoodi Drain, (Baghdad, Iraq),
W89-00890 2H

MULTIPURPOSE RESERVOIRS
Optimization Model for Screening Multipurpose Reservoir Systems,
W89-00703 6A

MULTIVARIATE ANALYSIS
Multivariate Nonparametric Tests for Trend in Water Quality,
W89-00863 7C

Multivariate Periodic ARMA (1,1) Processes,
W89-00967 7B

MUNICIPAL WASTES
Procedure for Evaluating Municipal Solid Waste Leachate Components Capable of Causing Volume Shrinkage in Compacted Clay Soils,
W89-00621 5E

Comparison of Co-Digestion Performance of Two Differently Collected Organic Fractions of Municipal Solid Waste with Sewage Sludges,
W89-00643 5D

MUNICIPAL WASTEWATER
Performance of Vinyl Core Media Trickling Filter Plant for Secondary Treatment of Municipal Wastewater,
W89-00502 5D

Removal of Pentachlorophenol in Municipal Activated Sludge Systems,
W89-00509 5D

Impact of a Municipal Wastewater Effluent on Water Quality, Periphyton, and Invertebrates in the Little Miami River Near Xenia, Ohio,
W89-00685 5C

Nitrilotriacetic Acid (NTA) Environmental Monitoring Program in Indiana: 1979 to 1983,
W89-01089 5A

Microbial Characterization of Municipal Wastewater at a Spray Irrigation Site: the Lubbock Infection Surveillance Study,
W89-01124 7B

Removal of Organic Toxic Pollutants by Trickling Filter and Activated Sludge,
W89-01133 5D

MUNICIPAL WATER
STASOFT: A User-Friendly Interactive Computer Program for Softening and Stabilisation of Municipal Waters,
W89-00935 5F

MUSSELS
Unionid (Mollusca:Bivalvia) Fauna of the Shenango River in Mercer County, Pennsylvania,
W89-00312 5C

Trace Metals in the Common Mussel Mytilus edulis (L.) in the Clyde Estuary,
W89-00823 5B

Micronucleus Test: Examples of Application to Marine Ecology,
W89-01042 5A

MUTAGENICITY
Mutagenicity in Pulp and Paper Mill Effluents and in Recipient,
W89-00370 5C

Review of the Use of XAD Resins to Concentrate Organic Compounds in Water,
W89-01215 5A

MUTAGENS
Effect of Permanganate Oxidation and Chlorination on the Mutagenic Activity and other Quality Parameters of Artificially Recharged Ground Water Processed from Humus-rich Surface Water,
W89-00599 5F

MYCOBACTERIUM
Efficacy of Chemical Dosing Methods for Isolating Nontuberculous Mycobacteria from Water Supplies of Dialysis Centers,
W89-00343 5A

MYXOBACTERIA
Myxococcal Predation on Cyanobacterial Populations: Nutrient Effects,
W89-01050 2H

NAMIB DESERT
Predictability of Two Moisture Sources in the Namib Desert,
W89-00455 2B

NAPHTHALENE
Contribution of Plasmids to Naphthalene Catabolism in Sediment Bacteria,
W89-00378 5B

NARCOSIS
Volume Fraction Correlation for Narcosis in Aquatic Organisms: The Key Role of Partitioning,
W89-01096 5C

NARRAGANSETT BAY
Nitrogen Dynamics in Lower Narragansett Bay: II. Phytoplankton Uptake, Depletion Rates of Nitrogenous Nutrient Pools, and Estimates of Ecosystem Remineralization,
W89-00215 2L

NATURAL DAMS
Formation and Failure of Natural Dams,
W89-00470 2J

NATURAL RESOURCES
Nature Conservation in the Moray Firth,
W89-00776 2L

Once and Future Experience of the California Coastal Conservancy,
W89-01067 6E

California Tahoe Conservancy: Applying the Principles,
W89-01068 6E

NATURAL WATERS
Can the Redox Conditions in Natural Waters be Predicted by a Single Parameter,
W89-00688 2K

NAVIGABLE RIVERS
Impacts of Navigation on Riverine Fish Production in the United States,
W89-00248 6G

Fish Production in the Kanawha River and its Relation To Barge Traffic,
W89-00249 6G

NAVIGATION CANALS
50th Anniversary of the Moscow Canal,
W89-00049 8A

Reliability and Safety Inspection of Hydraulic Structures of the Moscow Canal,
W89-00051 8A

Improvement of the Electrical Equipment and Control Systems to the Lock Mechanisms of the Moscow Canal,
W89-00052 8C

Motor-Boat-Derived Volatile Organic Compounds (VOC) in Lake water,
W89-00499 5B

NAVIGATION EFFECTS
Impacts of Navigation on Riverine Fish Production in the United States,
W89-00248 6G

Fish Production in the Kanawha River and its Relation To Barge Traffic,
W89-00249 6G

NEBRASKA
New Directions in Nebraska Water Policy,
W89-01266 6E

NEMATODES
Viability Determination of Ascaris Eggs Recovered from Waste-Water,
W89-00644 5A

NESTING
Effects of Fish Nests on Pattern and Zonation of Submersed Macrophytes in a Softwater Lake,
W89-00092 2H

NETHERLANDS
Model Output Statistics Forecasts: Three Years of Operational Experience in the Netherlands,
W89-00843 2B

NETWORK DESIGN
Statistical Methods and Sampling Design for Estimating Step Trends in Surface-Water Quality,
W89-00862 7A

Use of Network Analysis Techniques in the Development and Optimization of a large UK Urban Water Distribution System (L'Emploi de Techniques),
W89-00918 5F

Optimization of the Production and Pumping Costs of the Nice Water Network (Optimisation de la Production et des Pompages sur le Reseau d'Eau de Nice),
W89-00922 5F

Method for Locating Wells in a Groundwater Monitoring Network Under Conditions of Uncertainty,
W89-00971 7A

Sampling Strategies and Associated Errors in Estimating Epilimnetic Chlorophyll in Eutrophic Lakes,
W89-01242 2H

NETWORKS
Networking Urban Water Supplies in West Africa,
W89-00419 5F

Flow Simulation Using Channel Network Model,
W89-00751 7B

NEUSE RIVER
Modeling Blue-Green Algal Blooms in the Lower Neuse River,
W89-01225 5C

NEUTRALIZATION
Role of Chemical Weathering in the Neutralization of Acidic Deposition,
W89-00696 5B

NEVADA V. UNITED STATES
Water Rights: Enforcing the Federal-Indian Trust after Nevada v. United States,
W89-01010 6E

NEW JERSEY PINELANDS
Stream Chemistry in the New Jersey Pinelands: The Influence of Precipitation and Watershed Disturbance,
W89-00716 5B

NEW MEXICO
El Nino and Its Effect on Precipitation in Arizona and Western New Mexico,
W89-00474 2B

NEW YORK
Drainage Basin Control of Acid Loadings to Two Adirondack Lakes,
W89-00710 5B

Simulation of Regional Ground Water Flow in Bedrock, Southwestern New York-Northwestern Pennsylvania,
W89-00882 2F

NEW YORK STATE
Short-Term Trends in Sulfate Deposition at Selected Bulk Precipitation Stations in New York,
W89-00432 5B

NEW ZEALAND
Politics of Hydro-Megaprojects: Damming with Faint Praise in Australia, New Zealand, and British Columbia,
W89-00836 6E

NICE
Optimization of the Production and Pumping Costs of the Nice Water Network (Optimisation de la Production et des Pompages sur le Reseau d'Eau de Nice),
W89-00922 5F

NICKEL
Concentrations of Trace Metals in the Qiantagnjiang River and its Estuary in Southern China,
W89-00443 5B

Copper, Nickel, and Chrome Recovery in a Jobshop to Eliminate Waste Treatment and Sludge Disposal,
W89-00993 5D

NIEPOLOMICE FOREST
Effect of Drainage Basin on Heavy Metal Concentrations in Stream Waters in the Niepolomice Forest,
W89-00260 5B

NIGERIA
Rotifers of Warri River, Nigeria,
W89-00222 2H

NIGG BAY
Intertidal Macrofauna of Nigg Bay,
W89-00780 2L

Moray Firth Marine Fouling Communities,
W89-00781 2L

Pollution Control and Environmental Planning for the Beatrice Oilfield and Nigg Oil Terminal,
W89-00788 5G

Hydrocarbons in Nigg Bay Sediments,
W89-00790 5B

NITRATE
Nitrate and Ammonium Uptake by Plankton in an Amazon River Floodplain Lake,
W89-00229 2H

Nitrate Trace Determinations in Snow and Firn Core Samples of Ice Shelves at the Weddell Sea, Antarctica,
W89-01258 5B

NITRATES
Role of External Ammonium Inputs in Freshwater Acidification,
W89-00024 5B

Ammonium and Nitrate Uptake by Aquatic Plants from Poorly Buffered and Acidified Waters,
W89-00112 5C

Systems Approach to Nitrate Removal from Groundwater Supplies,
W89-00134 5F

Nitrate Reductase Activity in Phytoplankton from the Oslo-fjord, Norway,
W89-00226 2H

Determination of Nitrate at the Ng/g Level in Antarctic Snow Samples with Ion Chromatography and Isotope Dilution Mass Spectrometry,
W89-00269 5A

Comparisons of RADM and Oscar Precipitation Chemistry Data,
W89-00433 5B

Photochemical Reaction of Biphenyl in Water Containing Nitrite or Nitrate Ion,
W89-00593 5B

Phytoplankton Ecology of the Firth of Clyde Sea-Lochs Striven and Fyne,
W89-00813 2L

Fish, Fleas and Phytoplankton,
W89-00851 5C

Stream Nitrate Levels in a Small Catchment in South West England Over a Period of 15 Years (1970 - 1985),
W89-00915 5B

Contamination of Farmstead Wells by Pesticides, Volatile Organics, and Inorganic Chemicals in Kansas,
W89-00946 5B

Problem with Nitrates,
W89-00965 5B

Nitrate Removal from Water Supplies Using Biological Denitrification,
W89-01237 5F

Numerical Transport Model for Oxygen- and Nitrate-Based Respiration Linked to Substrate and Nutrient Availability in Porous Media,
W89-01251 5D

NITRIC ACID
Winter Cloud Water and Air Composition in Central Ontario,
W89-01265 5C

NITRIFICATION
Nitrogen Metabolism in the Brackish Lake Nakanoumi. III. Nitrification-Dentrification in Low Concentration of Dissolved Oxygen, (in Japanese),
W89-00769 2H

Removal of Organic Toxic Pollutants by Trickling Filter and Activated Sludge,
W89-01133 5D

NITRILOTRIACETIC ACID
Nitrilotriacetic Acid (NTA) Environmental Monitoring Program in Indiana: 1979 to 1983,
W89-01089 5A

NITRITES
Nitrite and Ammonia in the Tamar Estuary,
W89-00154 5B

Photochemical Reaction of Biphenyl in Water Containing Nitrite or Nitrate Ion,
W89-00593 5B

NITROGEN
Leaf Production and Nitrogen and Phosphorus Tissue Content of Littorella uniflora (L.) Aschers. in Relation to Nitrogen and Phosphorus Enrichment of the Sediment in Oligotrophic Lake Hampen, Denmark,
W89-00101 5C

Equations Relating Growth and Uptake of Nitrogen by Salvinia molesta to Temperature and the Availability of Nitrogen,
W89-00111 2H

Nitrogen, Phosphorus and Potassium in Salvinia molesta Mitchell in the Field: Effects of Weather, Insect Damage, Fertilizers and Age,
W89-00113 2H

Nutrient Dynamics in Minerotrophic Peat Mires,
W89-00119 2H

Animal Wastes Media for Spirulina Production,
W89-00136 5D

Nitrogen Dynamics in Lower Narragansett Bay: II. Phytoplankton Uptake, Depletion Rates of Nitrogenous Nutrient Pools, and Estimates of Ecosystem Remineralization,
W89-00215 2L

Concentrations of Nitrogen and Phosphorus in Waters of Two Hypertrophic Lakes and Their Effect on the Quantity of Phytoplankton Biomass,
W89-00245 2H

Frequent and Important Consequences from Increased Amounts of Liquid Manure (Haeufige und Wichtige Folgen Vermehrten Guelleanfalls),
W89-00500 5B

Distribution of Cadmium in Lake Tohya,
W89-00774 2H

NITROGEN COMPOUNDS
Evaluation of Seasonal Nutrient Dynamics in the Oosterschelde (SW Netherlands),
W89-00153 2L

Seasonal Variations and Spatial Gradients of Nitrogenous Nutrients in Waters of Southeastern Vancouver Island, British Columbia, Canada.
W89-00158 2L

Utilization of Nitrogenous Nutrients by Natural Phytoplankton in Enriched Lake Waters,
W89-00773 2H

NITROGEN CYCLE
Nitrogen Pools and Soil Characteristics of a Temperate Estuarine Wetland in Eastern Australia,
W89-00110 5B

Nitrogen Budget of the Scheldt Hydrographical Basin,
W89-00155 5B

Disruption of the Nitrogen Cycle in Acidified Lakes,
W89-00451 5C

Dynamics of Dissolved Silicium and Nitrogen-Nutrients at Low Temperature in the EMS-Dollard Estuary,
W89-00673 2L

NITROGEN FIXATION
Spatial Patterns of N Fixation (Acetylene Reduction) along Environmental Gradients in a Warm-Temperate Estuary,
W89-00475 2L

Relationship between Nitrogen-Fixing Sulfate Reducers and Fermenters in Salt Marsh Sediments and Roots of Spartina alterniflora,
W89-00732 2L

NITROGEN REMOVAL
Ammonia Nitrogen Removal in Attached-Growth Ponds,
W89-00489 5D

Nitrate Removal from Water Supplies Using Biological Denitrification,
W89-01237 5F

NOGALES
Multicriterion Selection of Wastewater Management Alternatives,
W89-00300 5D

NONPARAMETRIC TESTING
Nonparametric Approaches to Environmental Impact Assessment,
W89-00861 7C

NONPARAMETRIC TESTS
Multivariate Nonparametric Tests for Trend in Water Quality,
W89-00863 7C

Parametric and Nonparametric Tests for Dependent Data,
W89-00864 7C

Nonparametric Tests for Trend Detection in Water Quality Time Series,
W89-00867 7C

NONPOINT POLLUTIN SOURCES
Stream Nitrate Levels in a Small Catchment in South West England Over a Period of 15 Years (1970 - 1985),
W89-00915 5B

NONPOINT POLLUTION SOURCES
Factors Forming the Level and Dynamics of Nutrient Runoff from an Agricultural Watershed,
W89-00261 5B

Evaluation of Vegetation Filter Strips as a Best Management Practice for Feed Lots,
W89-01125 5G

Diffuse (Nonpoint) Pollution - A Political, Institutional, and Fiscal Problem,
W89-01134 5G

Bacterial Water Quality Responses to Four Grazing Strategies: Comparisons with Oregon Standards,
W89-01170 5B

NORTH CAROLINA
Modeling Blue-Green Algal Blooms in the Lower Neuse River,
W89-01225 5C

NORTH SEA
Availability of Phosphorus Sources for Blooms of Phaeocystis pouchetii (Haptophyceae) in the North Sea: Impact of the River Rhine,
W89-00004 2L

Modelling Research on the Production Cycle of Phytoplankton in the Southern Bight of the North Sea in Relation to Riverborne Nutrient Loads,
W89-00157 2L

NORTHERN GANNETTS
Organochlorines and Eggshell Thinning in Northern Gannets (Sula bassanus) from Eastern Canada, 1968-1984,
W89-01054 5C

NORWAY
Effect of Light Regime upon Growth Rate and Chemical Composition of a Clone of Skeletonema costatum from the Trondheimsfjord, Norway,
W89-00212 2L

Sea Use Planning in Norwegian Waters: National and International Dimensions,
W89-00289 6E

Sedimentation of Particulate Material in Two Shallow, Land-Locked Fjords in Western Norway,
W89-01008 2J

NOSTOC
Heavy-Metal Toxicity in the Cyanobacterium Nostoc linckia,
W89-00094 5C

NUCLEAR POWERPLANTS
Adaptation of Phytoplankton-Degrading Microbial Communities to Thermal Reactor Effluent in a New Cooling Reservoir,
W89-00336 5C

Reactor Accident at Chernobyl: A Possibility to Test Colloid-Controlled Transport of Radionuclides in a Shallow Aquifer,
W89-00990 5B

NUCLEATION
Theoretical Evaluation of Water Oligomer Populations in the Earth's Atmosphere,
W89-00763 2B

NUMERICAL ANALYSIS
Contaminant Transport in Fractured Porous Media: Steady State Solutions by a Boundary Integral Method,
W89-00982 5B

Numerical Transport Model for Oxygen- and Nitrate-Based Respiration Linked to Substrate and Nutrient Availability in Porous Media,
W89-01251 5D

NUTRIENT REQUIREMENTS
Equations Relating Growth and Uptake of Nitrogen by Salvinia molesta to Temperature and the Availability of Nitrogen,
W89-00111 2H

NUTRIENTS
Nutrient Release Through Decomposition of Diplodon Delodontus Expansus (Mollusca, Bivalvia) and Some Considerations of its Effects on the Ecology of a Small Tropical Reservoir,
W89-00009 2H

Nitrogen, Phosphorus and Potassium in Salvinia molesta Mitchell in the Field: Effects of Weather, Insect Damage, Fertilizers and Age,
W89-00113 2H

Tropical Wetlands as a Carbon Source,
W89-00118 2H

Role of Marsh Plants in the Transport of Nutrients as Shown by a Quantitative Model for the Freshwater Section of the Elbe Estuary,
W89-00120 2L

Outwelling from Tropical Tidal Salt Flats,
W89-00140 2L

Modelling Research on the Production Cycle of Phytoplankton in the Southern Bight of the North Sea in Relation to Riverborne Nutrient Loads,
W89-00157 2L

Seasonal Variations and Spatial Gradients of Nitrogenous Nutrients in Waters of Southeastern Vancouver Island, British Columbia, Canada.
W89-00158 2L

Examination of the Connection Between the Patchiness of Benthic Nutrient Efflux and Epiphytobenthos Patchiness on Intertidal Flats,
W89-00161 2L

Community Grazing and the Regulation of In Situ Clearance and Feeding Rates of Planktonic Crustaceans in Lakes in the Kuokkel Area, Northern Sweden,
W89-00181 2H

Factors Affecting Nutrient Dynamics in a Piedmont North Carolina Reservoir,
W89-00187 2H

Nitrate Reductase Activity in Phytoplankton from the Oslo-fjord, Norway,
W89-00226 2H

Nitrate and Ammonium Uptake by Plankton in an Amazon River Floodplain Lake,
W89-00229 2H

Nutrient and Light Limitation of Algae in Two Northern California Streams,
W89-00296 2H

Delayed Nutrient Responses to the Liming of Lake Gardsjon, Sweden,
W89-00441 5G

Effects of Sediment Nutrients on Seagrasses: Literature Review and Mesocosm Experiment,
W89-00523 2L

Dynamics of Dissolved Silicium and Nitrogen-Nutrients at Low Temperature in the EMS-Dollard Estuary,
W89-00673 2L

Phosphorus Determination in Rivers (Phosphor in Fliessgewaessern und Seine Analytische Bestimmung),
W89-00735 5A

Vertical Distribution of Phytoplankton in a Stratified Lake (Lago Dom Helvecio, Southeastern Brazil) with Special Reference to the Metalimnion,
W89-00768 2H

Utilization of Nitrogenous Nutrients by Natural Phytoplankton in Enriched Lake Waters,
W89-00773 2H

Peat Accumulation and the Success of Marsh Plants,
W89-00909 2H

Influence of Microphytobenthos on the Nutrient Flux between Sediment and Water: A Laboratory Study,
W89-01036 2L

Use of Duckweed for Wastewater Treatment,
W89-01128 5D

Factors Affecting the Efficiency of Some Estimates of Fluvial Total Phosphorus Load,
W89-01249 5B

NUTRITION
Biomass and Nutritive Potential of Vallisneria americana Michx in Navigation Pool 9 of the Upper Mississippi River,
W89-00093 2H

NYMPHAEA
Effects of the Season and of Water Chemistry on the Decomposition of Nymphaea alba L.: Weight Loss and Pyrolysis Mass Spectrometry of the Particulate Matter,
W89-00096 2H

OBSERVATION WELLS
Method for Locating Wells in a Groundwater Monitoring Network Under Conditions of Uncertainty,
W89-00971 7A

OCEAN DUMPING
Monitoring the Moray Firth Environment,
W89-00787 5C

OCHRE
Ochre Deposits and Associated Bacteria in Some Field Drains in Scotland,
W89-00412 2G

ODOR CONTROL
Controlling Swampy Odors in Drinking Water,
W89-00425 5F

Evaluation of Chemical Oxidizers for Hydrogen Sulfide Control,
W89-01129 5D

OHIO
Impact of a Municipal Wastewater Effluent on Water Quality, Periphyton, and Invertebrates in the Little Miami River Near Xenia, Ohio,
W89-00685 5C

OIL
Determination of Naphthenic Acids in California Crudes and Refinery Wastewaters by Fluoride Ion Chemical Ionization Mass Spectrometry,
W89-00209 5A

Waste Transformer Oil and PCB Toxicity to Rainbow Trout,
W89-00328 5C

OIL FIELDS
Microbial Biomass, Activity, and Community Structure of Water and Particulates Retrieved by Backflow from a Waterflood Injection Well,
W89-00334 5B

Macrobenthos of the Beatrice Oilfield, Moray Firth, Scotland,
W89-00782 2L

Comparison of the Fauna Retained On 0.5 mm and 1.0 mm Meshes from Benthic Samples Taken in the Beatrice Oilfield, Moray Firth, Scotland,
W89-00783 2L

OIL POLLUTION
Bacterial Degradation of Crude Oil Water Pollutants in Danube Water (Die bakterielle Degradation von Erdolkohlenwasserstoffen im Donauwasser),
W89-00168 5B

Homing of Adult Chinook Salmon after Brief Exposure to Whole and Dispersed Crude Oil,
W89-00375 5C

Biochemical Composition of the Blue Crab Callinectes sapidus Exposed to the Water-Soluble Fraction of Crude Oil,
W89-00391 5C

Toxic and Environmental Torts within Admiralty,
W89-00518 6E

Hazardous and Noxious Substances,
W89-00519 5G

Global Environment: A Proposal to Eliminate Marine Oil Pollution,
W89-00521 5G

Effects of Oil Contamination on Colonization of Marine Periphytic Microflora,
W89-00681 5C

Oil Pollution in the Cromarty Firth and Inshore Moray Firth,
W89-00785 5B

Monitoring the Moray Firth Environment,
W89-00787 5C

Pollution Control and Environmental Planning for the Beatrice Oilfield and Nigg Oil Terminal,
W89-00788 5G

Hydrocarbons in Nigg Bay Sediments,
W89-00790 5B

Degradation of Low-Toxicity Oil-Based Drilling Mud in Benthic Sediments around the Beatrice Oilfield,
W89-00792 5B

Population Genetics of Mytilus edulis (L.) from Oslofjorden, Norway in Oil-Polluted and Non Oil-Polluted Water,
W89-01009 5C

Results of Ecological Monitoring of Three Beaches Polluted by the 'Amoco Cadiz' Oil Spill: Development of Meiofauna from 1978 to 1984,
W89-01031 5C

OIL POLLUTION SOURCES
Use of Total Organic Carbon as an Indicator of Contamination from an Oil Refinery, South-Central Kansas,
W89-00942 5A

OIL SHALE
Leaching of Retorted Oil Shale: Assessing the Toxicity to Colorado Squawfish, Fathead Minnows, and Two Food-Chain Organisms,
W89-00329 5C

OIL SPILLS
Sea Use Planning in Norwegian Waters: National and International Dimensions,
W89-00289 6E

Long Term Impact of Dissolved Dispersed Petroleum Hydrocarbons (DDPH) in Gulf of Iskenderun,
W89-00567 5B

Hydrocarbon Fuel Spill Dispersion on Water: A Literature Review,
W89-00598 5B

Results of Ecological Monitoring of Three Beaches Polluted by the 'Amoco Cadiz' Oil Spill: Development of Meiofauna from 1978 to 1984,
W89-01031 5C

OIL WASTES
Effect of Sulphide on the Anaerobic Degradation of Propionate,
W89-00625 5D

Use of Total Organic Carbon as an Indicator of Contamination from an Oil Refinery, South-Central Kansas,
W89-00942 5A

OKAVANGO RIVER
Roles of Sedimentation and Plant Growth in Changing Flow Patterns in the Okavango Delta, Botswana,
W89-00457 2J

OKLAHOMA
Habitat Use of Two Darter Species in Glover River, Oklahoma,
W89-00396 2H

OLIGOMERS
Sorption of Cationic Oligomers on Sediments,
W89-01094 5B

OLIGOTROPHIC LAKES
Effects of Fish Nests on Pattern and Zonation of Submersed Macrophytes in a Softwater Lake,
W89-00092 2H

Community Grazing and the Regulation of In Situ Clearance and Feeding Rates of Planktonic Crustaceans in Lakes in the Kuokkel Area, Northern Sweden,
W89-00181 2H

Microbially Mediated Mn(II) Oxidation in an Oligotrophic Arctic Lake,
W89-00335 2H

Structure of a Population of Lobelia dortmanna L. Along a Gradient of Increasing Depth in an Oligotrophic Lake,
W89-00525 2H

Eutrophication and Benthic Fauna of Three Mountain Lakes (Eutrophisation et Faune Benthique de Trois Lacs de Montagne),
W89-00695 5C

ONTARIO
Field Measurements of Water-Air Exchange of Mercury in Freshwater Systems,
W89-00640 5A

OOSTERSCHELDE ESTUARY
Evaluation of Seasonal Nutrient Dynamics in the Oosterschelde (SW Netherlands),
W89-00153 2L

OPERATING COSTS
GAC Treatment Cost Experience at Two Drinking Water Utilities,
W89-00495 5F

O and M Spending Levels in Third World Irrigation Systems: Exploring Economic Alternatives,
W89-00874 3F

OPERATING POLICIES
Influence of Feeding Procedure on Microbial Reductions and Performance of Anaerobic Digestion,
W89-00511 5D

Regulation of the River Dee,
W89-00953 4A

Regulation of the River Thames: A Case Study on the Teddington Flow Proposal,
W89-00955 4A

Selecting a Contract Operator for Your Water or Wastewater Facility,
W89-01100 5F

OPERATIONAL HYDROLOGY
Operational Models for Flood Calculations,
W89-01030 2A

OPTICAL PROPERTIES
Chlorophyll Relationships in Letowo and Szczytno Male Lakes, with Trout Cage Culture,
W89-00262 2H

OPTIMIZATION MODELS
Optimization Model for Screening Multipurpose Reservoir Systems,
W89-00703 6A

ORANGE ESTUARY
Fluvial Sedimentation in the Ebb-Dominated Orange Estuary,
W89-00456 2J

OREGON
Longitudinal Changes in Fish Assemblages and Water Quality in the Willamette River, Oregon,
W89-00029 2H

Flow Capacity of Culverts on Oregon Coast Range Forest Roads,
W89-00878 8B

Bacterial Water Quality Responses to Four Grazing Strategies: Comparisons with Oregon Standards,
W89-01170 5B

ORGANIC ACIDS
Determination of Naphthenic Acids in California Crudes and Refinery Wastewaters by Fluo-

ride Ion Chemical Ionization Mass Spectrometry,
W89-00209 5A

Review of the Behaviour and Utilization of Polycarboxylic Acids as Detergent Builders,
W89-00620 5D

ORGANIC CARBON
Determination of Organic Matter in River Sediments,
W89-00169 7B

Diel and Seasonal Carbon Budgets in Two Cold Spring Ecosystems,
W89-00177 2H

Flux of Organic Carbon in a Tidal Salt Marsh, Kowie River Estuary, Port Alfred, South Africa,
W89-00453 2L

Degradation and Formation of Refractory DOM by Bacteria During Simultaneous Growth on Labile Substrates and Persistent Lake Water Constituents,
W89-00691 2H

Dissolved Organic Carbon and Manganese in the Boundary of the Oxic and Anoxic Layers in Lakes Fukami-ike and Suigetsu-ko,
W89-00771 2H

Use of Total Organic Carbon as an Indicator of Contamination from an Oil Refinery, South-Central Kansas,
W89-00942 5A

Statistical Correlations for Predicting the Partition Coefficient for Nonpolar Organic Contaminants Between Aquifer Organic Carbon and Water,
W89-00992 5B

Copper Binding by Dissolved Organic Matter: I. Suwannee River Fulvic Acid Equilibria,
W89-01077 5B

Copper Binding by Dissolved Organic Matter: II. Variation in Type and Source of Organic Matter,
W89-01078 5B

Release of Micro-algal Photosynthate and Associated Bacterial Uptake and Heterotrophic Growth,
W89-01187 2H

ORGANIC COMPOUNDS
Analysis of ppb Levels of Organics in Water by Means of Purge-and-Trap, Capillary Gas Chromatography and Selective Detectors,
W89-00288 5A

Sensitivity of Young Striped Bass to Organic and Inorganic Contaminants in Fresh and Saline Waters,
W89-00320 5C

Effects of Organic Contaminants on Reproduction of the Starry Flounder Platichthys stellatus in San Francisco Bay. I. Hepatic Contamination and Mixed-Function Oxidase (MFO) Activity During the Reproductive Season,
W89-00385 5C

Seasonal and Temporal Changes of Organic Compounds in Rain and Snow,
W89-00429 5B

Purge and Trap Analysis of Aqueous Samples with Cryofocusing,
W89-00446 5A

Sorption of Hydrophobic Chemicals from Water: A Hypothesis for the Mechanism of the Particle Concentration Effect,
W89-00585 5B

Ca(+2)-Stress, Biological Response and Particle Aggregation in the Aquatic Habitat,
W89-00669 2K

Flocculation and De-Flocculation of Suspended Matter in Estuaries,
W89-00671 2L

Numerical Modeling of Sorption Kinetics of Organic Compounds to Soil and Sediment Particles,
W89-00981 5B

Statistical Correlations for Predicting the Partition Coefficient for Nonpolar Organic Contaminants Between Aquifer Organic Carbon and Water,
W89-00992 5B

Effects of Three Organics on Selected Physical Properties of Type I Portland Cement,
W89-00994 5E

Aerobic Biodegradation of Natural and Xenobiotic Organic Compounds By Subsurface Microbial Communities,
W89-01090 5B

Estimating the Acute Toxicity of Waterborne Chemicals in Trout from Measurements of Median Lethal Dose and the Octanol-Water Partition Coefficient,
W89-01095 5C

Volume Fraction Correlation for Narcosis in Aquatic Organisms: The Key Role of Partitioning,
W89-01096 5C

Comparing Headspace with Purge and Trap for Analysis of Volatile Priority Pollutants,
W89-01119 5A

Biosorption of Organic Halide in a Kraft Mill Generated Lagoon,
W89-01138 5D

Occurrence and Distribution of Trace Organic Compounds in Bermuda Precipitation,
W89-01148 5B

Review of the Use of XAD Resins to Concentrate Organic Compounds in Water,
W89-01215 5A

Estimating Soil/Sediment Partition Coefficients for Organic Compounds by High Performance Reverse Phase Liquid Chromatography,
W89-01223 5B

Fate and Transport of Organics in Soil: Model Predictions and Experimental Results,
W89-01239 5B

ORGANIC MATTER
Development of Microorganisms on the Background of Organic Matter in Forest Ecosystem Waters,
W89-00080 2H

Evaluation of Seasonal Nutrient Dynamics in the Oosterschelde (SW Netherlands),
W89-00153 2L

Determination of Organic Matter in River Sediments,
W89-00169 7B

Effect of Sulfate and Organic Matter on The Hydrogen Sulfide Formation in Biofilms of Filled Sanitary Sewers,
W89-00510 5D

Formation of Oxygen Species and Their Reactions with Organic Chemicals in Aqueous Solution,
W89-00575 5B

Investigation of the Production of Lipophilic Volatile Organohalogen Materials during Laboratory Chlorination of some Ground Water Samples from Yugoslavia,
W89-00608 5F

Size Distribution and Copper Association of Dissolved Organic Material in Urban Runoff,
W89-00628 5B

Pelagic Ecosystem Model Simulating Production and Sedimentation of Biogenic Particles: Role of Salps and Copepods,
W89-01041 2L

Spatial Patchiness in the Lacustrine Sedimentary Environment,
W89-01048 2H

Sediments in the Estuarine Environment of the Tigris/Euphrates Delta; Iraq; Arabian Gulf,
W89-01083 2L

Ozone-Induced Particle Destabilization,
W89-01120 5F

ORGANIC SOLVENTS
Nonaqueous Phase Liquid Transport and Cleanup: II. Experimental Studies,
W89-00969 5B

ORGANIC WASTES
Hydrocarbon and Pollutant Levels in the Cromarty Firth,
W89-00791 5B

ORGANIZATIONS
Hydrological Perspective,
W89-01011 2A

ORGANO-TINS
Determination of Organotins in Natural Waters by Toluene Extraction and Graphite Furnace AAS,
W89-00743 5A

ORINOCO RIVER
Primary Production in the Orinoco River,
W89-00907 2H

ORKNEY ISLANDS
Development of Mass Blooms of Photosynthetic Bacteria on Sheltered Beaches in Scapa Flow, Orkney Islands,
W89-00795 2L

Marine Pollution in Orkney,
W89-00796 5G

OROGRAPHIC PRECIPITATION
Aerosol and Hydrometeor Concentrations and Their Chemical Composition during Winter Precipitation along a Mountain Slope: I. Temporal Evolution of the Aerosol, Microphysical and Meteorological Conditions,
W89-01150 2B

OSLO FJORD
Nitrate Reductase Activity in Phytoplankton from the Oslo-fjord, Norway,
W89-00226 2H

OTTER
Organochlorine and Mercury Residues in Wild Mink and Otter: Comparison with Fish,
W89-01093 5B

OUTFALL
Analysis of Turbulent Buoyant Jet in Density-Stratified Water,
W89-00491 5B

Horizontal Round Buoyant Jet in Shallow Water,
W89-00902 5E

OUTFALL SEWERS
Water Quality in the Inverness and Beauly Firths,
W89-00789 5B

OUTLETS
Outlet Structure Design for Conduits and Tunnels,
W89-00307 8A

OVERFLOW CHANNELS
Experience in Operating Hydraulic Structures and Equipment of Hydroelectric Stations,
W89-00554 8C

OVERLAND FLOW
Pipe Flow in James Bay Coastal Wetlands,
W89-00047 2A

OXIDATION
Microbially Mediated Mn(II) Oxidation in an Oligotrophic Arctic Lake,
W89-00335 2H

Photochemical Reaction of Biphenyl in Water Containing Nitrite or Nitrate Ion,
W89-00593 5B

Effect of Permanganate Oxidation and Chlorination on the Mutagenic Activity and other Quality Parameters of Artificially Recharged Ground Water Processed from Humus-rich Surface Water,
W89-00599 5F

Iron Oxide Formation in Artificial Ground Waters,
W89-00687 2F

Can the Redox Conditions in Natural Waters be Predicted by a Single Parameter,
W89-00688 2K

Interpretation and Measurement of Redox Intensity in Natural Waters: A Comment to T. Frevert's Paper, 'Can the Redox Conditions in Natural Waters be Predicted by a Single Parameter',
W89-00689 2K

Microporous Filters with Oxidizing Power for Iron and Manganese Removal from Water,
W89-00889 5F

Evaluation of Chemical Oxidizers for Hydrogen Sulfide Control,
W89-01129 5D

Kinetics of Sulfide Oxidation by Dissolved Oxygen,
W89-01130 5D

OXIDATION DITCHES
Effect of Environmental Conditions on the Occurrence of Microthrix parvicella in Activated Sludge,
W89-01217 5D

OXIDATION PONDS
Measurement of Primary Productivity in a High-Rate Oxidation Pond (HROP),
W89-00213 2H

OXIDATION-REDUCTION POTENTIAL
Can the Redox Conditions in Natural Waters be Predicted by a Single Parameter,
W89-00688 2K

Interpretation and Measurement of Redox Intensity in Natural Waters: A Comment to T. Frevert's Paper, 'Can the Redox Conditions in Natural Waters be Predicted by a Single Parameter',
W89-00689 2K

Manganese Oxidation in pH and O2 Microenvironments Produced by Phytoplankton,
W89-01045 2K

OXIDES
Iron Oxide Formation in Artificial Ground Waters,
W89-00687 2F

Other Forms of Environmental Pollution,
W89-00794 5B

OXYGEN
Oxygen Budget of a River in Submerged Macrophytes (River Zschopau in the South of the GDR),
W89-00137 2H

Formation of Oxygen Species and Their Reactions with Organic Chemicals in Aqueous Solution,
W89-00575 5B

Simple and Efficient New Design of the Submersible Stirrer for the YSI Dissolved Oxygen Meter,
W89-00936 7B

OXYGEN BALANCE
Impact of Impounding on the Oxygen Balance of the Danube from Kelheim to Jochenstein Microbiological-Biochemical Investigations and Water Quality Model Calculations (Zum Einfluss der Straureglierung auf den Sauerstoffhaushalt der Donaustrecke Kelheim-Jochenstein: Mikrobiologisch-biochemische Untersuchungen und Gutemodellrechnungen),
W89-00173 6G

Benthic Chamber for Use in Rivers: Testing against Oxygen Mass Balances,
W89-00488 7B

OXYGEN BUDGET
Oxygen Budget of a River in Submerged Macrophytes (River Zschopau in the South of the GDR),
W89-00137 2H

OXYGEN DEMAND
Comparison of Instream and Laboratory Methods of Measuring Sediment Oxygen Demand,
W89-00869 7B

OXYGEN DEPLETION
Biochemical Models for the Hypolimnetic Oxygen Depletion in Lakes Impacted by Wastewater Discharges: 1. Alternative models,
W89-00186 5C

Biochemical Models for the Hypolimnetic Oxygen Depletion in Lakes Impacted by Wastewater Discharges: 2. Phytoplankton Biomass Model,
W89-00189 5C

OXYGEN ISOTOPES
Relationship Between delta-D and delta-18-O Values of Falling Snow Particles from a Separate Cloud,
W89-00406 2C

Stable Isotope Study of Recharge Processes in the English Chalk,
W89-01197 2F

OXYGEN TRANSFER
Oxygen Transfer Through Flexible Tubing and Its Effects on Ground Water Sampling Results,
W89-00943 5A

OYSTERS
Polyethylene Glycol Precipitation for Recovery of Pathogenic Viruses, Including Hepatitis A Virus and Human Rotavirus, from Oyster, Water, and Sediment Samples,
W89-00730 5A

OZONATION
Destruction of Polychlorinated Dibenzo-p-Dioxins and Dibenzofurans in Contaminated Water Samples Using Ozone,
W89-00606 5D

High Level Disinfection of Wastewaters for Reuse,
W89-00642 5D

Degradation of Polycyclic Aromatic Hydrocarbons: III. Reaction Products of the Ozonolysis of Further Polycyclic Aromatic Hydrocarbons in Aqueous Systems (Zum Abbau von Polycyclischen Aromatischen Kohlenwasserstoffen: III. Reaktionsprodukte der Umsetzung von Weiteren Polycyclischen Aromatischen Kohlenwasserstoffen in Wasser mit Ozon),
W89-00739 5F

Bulking Control with Ozonation in a Nutrient Removal Activated Sludge System,
W89-00930 5D

Ozone-Induced Particle Destabilization,
W89-01120 5F

Mechanism of Inactivation of Tobacco Mosaic Virus with Ozone,
W89-01229 5F

PAHALGAM HYDRO SCHEME
Planning and Construction of the Pahalgam Scheme,
W89-01004 8A

PALEOHYDROLOGY
Geomorphology, Offshore Bathymetry and Quaternary Lithostratigraphy around the Bot River Estuary,
W89-00649 2L

Experimental Marvin Windshield Effects on Precipitation Records in Leadville, Colorado,
W89-00876 7B

PAPYRUS
Effects of a Cyperus papyrus L. Swamp on Domestic Waste Water,
W89-00107 5D

PARAMETRIC TESTS
Parametric and Nonparametric Tests for Dependent Data,
W89-00864 7C

PARANOA RESERVOIR
Seasonal and Short-Term Fluctuations in the Zooplankton Community of Paranoa Reservoir, Brasilia, Federal District, Brazil (Flutuacoes Sazonais e de Curta Duracao na Comunidade Zooplanktonica do Lago Paranoa, Brasilia-DF, Brasil),
W89-00006 2H

PARASITES
Effect of Several Methods of Aquatic Plant Control on Two Bilharzia-Bearing Snail Species,
W89-00117 4A

Viability Determination of Ascaris Eggs Recovered from Waste-Water,
W89-00644 5A

PARATHION
Biotic and Abiotic Degradation Rates of Methyl Parathion in Freshwater and Estuarine Water and Sediment Samples,
W89-00601 5B

PARTICLE FORMATION
Factors Affecting Coagulation with Aluminum Sulfate: I. Particle Formation and Growth,
W89-01221 5F

PARTICLE GROWTH

Factors Affecting Coagulation with Aluminum Sulfate: I. Particle Formation and Growth,
W89-01221 5F

PARTICLE SIZE

Size Distribution and Copper Association of Dissolved Organic Material in Urban Runoff,
W89-00628 5B

PARTICULATE MATTER

Sedimentation of Particulate Material in Two Shallow, Land-Locked Fjords in Western Norway,
W89-01008 2J

Clearance of Bacteria-Sized Particles by Natural Populations of Nanoplankton in the Chesapeake Bay Outflow Plume,
W89-01032 2L

Pelagic Ecosystem Model Simulating Production and Sedimentation of Biogenic Particles: Role of Salps and Copepods,
W89-01041 2L

Discrimination between Algae and Artificial Particles by Freshwater and Marine Copepods,
W89-01047 2H

Ozone-Induced Particle Destabilization,
W89-01120 5F

PATH OF POLLUTANTS

Role of External Ammonium Inputs in Freshwater Acidification,
W89-00024 5B

Chemistry of Atmospheric Precipitation in the Babia Gora National Park,
W89-00082 5B

Solubilities of Trace Copper and Lead Species and the Complexing Capacity of River Water in the Linggi River Basin,
W89-00084 5B

Chemical Environment of Salvinia molesta Mitchell: Ionic Concentrations of Infested Waters,
W89-00106 5B

Nitrogen Pools and Soil Characteristics of a Temperate Estuarine Wetland in Eastern Australia,
W89-00110 5B

River Ems: Processes Affecting the Behaviour of Metals and Organochlorines during Estuarine Mixing,
W89-00149 5B

Nitrite and Ammonia in the Tamar Estuary,
W89-00154 5B

Nitrogen Budget of the Scheldt Hydrographical Basin,
W89-00155 5B

Investigations of the Ecotoxicological Effect of an Herbicide in an Aquatic Model Ecosystem: II. Food Chain Significance and Pesticide Balance (Untersuchungen zur okotoxikologischen Wirkung eines Herbizids in einem aquatischen Modellokosystem: II. Nahrungskettenprobleme und Schadstoffbilanzierung),
W89-00175 5C

Model Ecosystems as a Tool in Freshwater and Marine Research,
W89-00180 5B

New Aspects of the Sulfur Cycle, with Special Reference to Shallow Waters,
W89-00183 5B

Preliminary Study on the Migration and Transformation of Heavy Metals in the Sewage-Seawater Mixing Zone of Jinzhou Bay, (in Chinese),
W89-00199 5B

Characteristics of Distribution and Migration of Phosphorus in Deposits of Dianchi Lake, (in Chinese),
W89-00200 5B

Chemical Mechanisms of Heavy Metal Transport in Waters of Mala Panew and Brynica Rivers (Silesia, Poland),
W89-00251 5B

Effect of Drainage Basin on Heavy Metal Concentrations in Stream Waters in the Niepolomice Forest,
W89-00260 5B

Factors Forming the Level and Dynamics of Nutrient Runoff from an Agricultural Watershed,
W89-00261 5B

Chernobyl 134Cs, 137Cs, and 210Pb in High Mountain Lake Sediment: Measurements and Modeling of Mixing Process,
W89-00271 5B

Changes in Rainwater Acidity Associated with Closure of a Copper Smelter,
W89-00272 5B

Exchange of Phosphorus between a Euhaline Vegetated Marsh and the Adjacent Tidal Creek,
W89-00283 5B

Dissolved Mercury Behaviour in the Saint Lawrence Estuary,
W89-00285 5B

Aliphatic and Polycyclic Aromatic Hydrocarbons in Urban Rain, Snow and Fog,
W89-00309 5B

Distribution of Chlorinated Organic Substances from Pulp Mills,
W89-00359 5B

Investigations of Chlorinated Thiophenes: A Group of Bioaccumulable Compounds Identified in the Effluents from Kraft Bleaching,
W89-00360 5B

Modelling of Flow Through Potash Tailings Piles,
W89-00388 5B

Biochemical Composition of the Blue Crab Callinectes sapidus Exposed to the Water-Soluble Fraction of Crude Oil,
W89-00391 5C

Soil Solution in a Soil Treated with Digested Sewage Sludge,
W89-00413 5B

Rain-Aerosol Coupling in Urban Area: Scavenging Ratio Measurement and Identification of Some Transfer Processes,
W89-00430 2B

Sensitivity of Coral Reefs to Environmental Pollution,
W89-00440 5C

Regional Hydrogeology of Agricultural Drainage Wells in Iowa,
W89-00471 5B

Modified Fickian Model for Solute Uptake by Runoff,
W89-00486 5B

Geostatistics Applied to Groundwater Pollution: III. Global Estimates,
W89-00493 5B

Contaminant Propagation in Distribution Systems,
W89-00494 5F

Frequent and Important Consequences from Increased Amounts of Liquid Manure (Haeufige und Wichtige Folgen Vermehrten Guelleanfalls),
W89-00500 5B

Influence of Selected Organic Complexing Agents on the Sorption of Heavy Metals in River Sediments (Einfluss Ausgewaehlter Organischer Komplexbildner auf die Sorption von Schwermetallen an Gewaessersedimente),
W89-00501 5B

Innovative Septic System Management,
W89-00508 5D

Hazardous and Noxious Substances,
W89-00519 5G

International Control of Cross-Media Pollution: An Ecosystem Approach,
W89-00520 5G

Hydrological Features of Poyang Lake (II), (in Chinese),
W89-00535 2H

Chromium Speciation in the Huanghe River and Its Estuarine Region, (in Chinese),
W89-00544 5B

Sediment-Water Partition Coefficients and HPLC Retention Factors of Aromatic Hydrocarbons,
W89-00560 5B

Lignin Residues as Tracers of Organic Waste Transport,
W89-00561 7B

Environmental Conditions in Abu Kir Bay, East of Alexandria: I. Physico-chemical Characteristics and Water Circulation,
W89-00565 5B

Correlation of Some Organic Pollution Factors in Water Systems in Northern Greece,
W89-00566 5B

Long Term Impact of Dissolved Dispersed Petroleum Hydrocarbons (DDPH) in Gulf of Iskenderun,
W89-00567 5B

Two Toxicants, Mercury and Tin in the Gulf of Iskenderun,
W89-00570 5B

Comparative Study of Heavy Metals Pollution in Various Rivers and Lakes of Northern Greece,
W89-00571 5B

Heavy Metal Pollution in the Guadiamar River and the Guadalquivir Estuary (South West Spain),
W89-00573 5B

Bacteriological Contamination of the Eastern Part of the Gulf of Trieste (North Adriatic) Due to Sewage Discharge,
W89-00577 5B

Environmental Conditions in Abu Kir Bay, East of Alexandria: II. Plankton Distribution, Downstream from Land-Based Effluents,
W89-00578 5C

Association Between Seawater Pollution as Measured by Bacterial Indicators and Morbidity Among Bathers at Mediterranean Bathing Beaches of Israel,
W89-00579 5C

Coordinated Programme for Research and Monitoring of Pollution in the Mediterranean,
W89-00582 5A

Bioavailability of Polychlorinated Dibenzo-p-dioxins and Dibenzofurans from Contaminated Wisconsin River Sediment to Carp,
W89-00583 5B

Sedimentation of 74 PCB Congeners in the Upper Hudson River,
W89-00584 5B

Sorption of Hydrophobic Chemicals from Water: A Hypothesis for the Mechanism of the Particle Concentration Effect,
W89-00585 5B

Formation of 1-Nitropyrene by Photolysis of Pyrene in Water Containing Nitrite Ion,
W89-00586 5B

Survey of Mercury, Lead and Cadmium in Muscle of British Freshwater Fish,
W89-00587 5B

Leaching of Mercury from Peat Soil,
W89-00592 5B

Age to PCB Concentration Relationship with the Striped Bass (Morone saxatilis) in the Hudson River and Long Island Sound,
W89-00597 5B

Hydrocarbon Fuel Spill Dispersion on Water: A Literature Review,
W89-00598 5B

Long-term Study of Ecosystem Contamination with 2,3,7,8-Tetrachlorodibenzo-p-dioxin,
W89-00603 5B

Monitoring of PCDDs in Osaka Bay Using Blue Mussel,
W89-00604 5B

Emissions of Chlorinated Organics from a Municipal Sewage Sludge Burning Incinerator,
W89-00607 5B

Polychlorinated Biphenyls in the Kupa River, Croatia, Yugoslavia,
W89-00609 5B

Polybrominated Biphenyl Ethers in Marine Fish, Shellfish, and River and Marine Sediments in Japan,
W89-00610 5B

Creosote Compounds in Snails Obtained from Pensacola Bay, Florida, near an Onshore Hazardous-Waste Site,
W89-00611 5B

Analysis of Halogenated Polycyclic Aromatic Hydrocarbons in Urban Air, Snow and Automobile Exhaust,
W89-00613 5B

Chlorinated Hydrocarbons in Sediments of the Elbe River and the Elbe Estuary,
W89-00614 5B

Contributions of Heavy Metals from Municipal Runoff to the Sediments of Lake Pontchartrain, Louisiana,
W89-00618 5B

Effect of pH and Contact Time on the Concentration of As(III) and As(V) in Coal Ash Systems,
W89-00624 5E

Investigation of Transport-Processes along the Elbe River Using Chernobyl Radionuclides as Tracers,
W89-00636 5B

Field Measurements of Water-Air Exchange of Mercury in Freshwater Systems,
W89-00640 5A

Partitioning of Organochlorines Between Water, Particulate Matter and Some Organisms in Estuarine and Marine Systems of the Netherlands,
W89-00672 5B

Interpretation of Metal Profiles in a Sediment Core from Lake Geneva: Metal Mobility or Pollution,
W89-00694 5B

Dispersion in Heterogeneous Porous Media: 1. Local Volume Averaging and Large-Scale Averaging,
W89-00699 5B

Dispersion in Heterogeneous Porous Media: 2. Predictions for Stratified and Two-Dimensional Spatially Periodic Systems,
W89-00700 5B

Drainage Basin Control of Acid Loadings to Two Adirondack Lakes,
W89-00710 5B

Stream Chemistry in the New Jersey Pinelands: The Influence of Precipitation and Watershed Disturbance,
W89-00716 5B

Microscale Haline Convection - A Proposed Mechanism for Transport and Mixing at the Water Table Region,
W89-00718 2F

Conjugal Transfer of R68.45 and FP5 between Pseudomonas aeruginosa Strains in a Freshwater Environment,
W89-00728 5B

Effects of Acidification on Mercury Methylation, Demethylation, and Volatilization in Sediments from an Acid-Susceptible Lake,
W89-00731 5B

Distribution of Cadmium in Lake Tohya,
W89-00774 2H

Oil Pollution in the Cromarty Firth and Inshore Moray Firth,
W89-00785 5B

Monitoring the Moray Firth Environment,
W89-00787 5C

Water Quality in the Inverness and Beauly Firths,
W89-00789 5B

Hydrocarbons in Nigg Bay Sediments,
W89-00790 5B

Hydrocarbon and Pollutant Levels in the Cromarty Firth,
W89-00791 5B

Degradation of Low-Toxicity Oil-Based Drilling Mud in Benthic Sediments around the Beatrice Oilfield,
W89-00792 5B

Other Forms of Environmental Pollution,
W89-00794 5B

Effluent Disposal and the Physical Environment,
W89-00804 5E

Basic Encoded Model for One-Dimensional Ground Water Systems Incorporating First-Order Degradation Kinetics,
W89-00888 5B

Groundwater Velocity Magnitude in Radionuclide Transport Calculations,
W89-00903 5B

Interactions Between Groundwater Seepage and Sediment Porewater Sulphate Concentration Profiles in Lake Anna, Virginia,
W89-00910 5B

Recreation Resource Allocation Model for Public Drinking Reservoirs,
W89-00921 6D

Modeling Contaminant Propagation in Drinking Water Distribution Systems,
W89-00929 5F

Continuum Models for Contaminant Transport in Fractured Porous Formations,
W89-00966 5B

Nonaqueous Phase Liquid Transport and Cleanup: I. Analysis of Mechanisms,
W89-00968 5B

Nonaqueous Phase Liquid Transport and Cleanup: II. Experimental Studies,
W89-00969 5B

Continuum Approach for Modeling Mass Transport in Fractured Media,
W89-00980 5B

Numerical Modeling of Sorption Kinetics of Organic Compounds to Soil and Sediment Particles,
W89-00981 5B

Contaminant Transport in Fractured Porous Media: Steady State Solutions by a Boundary Integral Method,
W89-00982 5B

Theoretical Analysis of Deviations from Local Equilibrium During Sorbing Solute Transport Through Idealized Stratified Aquifers,
W89-00987 5B

Sorption Nonequilibrium During Solute Transport,
W89-00988 5B

Reactor Accident at Chernobyl: A Possibility to Test Colloid-Controlled Transport of Radionuclides in a Shallow Aquifer,
W89-00990 5B

Sorption and Desorption Dynamics of Aroclor 1242 to Natural Sediment,
W89-00991 5B

Statistical Correlations for Predicting the Partition Coefficient for Nonpolar Organic Contaminants Between Aquifer Organic Carbon and Water,
W89-00992 5B

Estimation of the Risk Associated with the Organic Constituents of Hazardous and Municipal Waste Landfill Leachates,
W89-00995 5B

Erosion and Sediment Yield Research: Some Recent Perspectives,
W89-01015 2J

Status of Isotope Hydrology Today,
W89-01018 2A

Groundwater Flow and Transport Modeling,
W89-01025 2F

Transport of Solutes in Soils and Aquifers,
W89-01027 5B

Contaminant Hydrogeology Dollars and Sense,
W89-01028 5B

Use of Factorial Experimental Design to Evaluate How Biotic and Abiotic Factors Influence

Cadmium Accumulation in the Unicellular Alga Dunaliella bioculata,
W89-01043 5B

Variations in Polychlorinated Biphenyl Congener Composition in Eggs of Mediterranean Water Birds in Relation to their Position in the Food Chain,
W89-01056 5B

Utility of Laboratory Streams for Ecosystem Toxicity Studies,
W89-01059 5B

Reactivity of the Carbonate Radical with Aniline Derivatives,
W89-01088 5B

Organochlorine and Mercury Residues in Wild Mink and Otter: Comparison with Fish,
W89-01093 5B

Sorption of Cationic Oligomers on Sediments,
W89-01094 5B

Source Protection and the Small Utility,
W89-01116 5G

Coping with Groundwater Contamination,
W89-01135 5G

Sorption and Degradation of Aldicarb and Its Oxidation Products in a Soil-Water Flow System as a Function of pH and Temperature,
W89-01164 5B

Annual Elemental Input/Output Estimates for Two Forested Watersheds in Eastern Tennessee,
W89-01168 5B

Stream Acidification Trends in the Welsh Uplands: A Modelling Study of the Llyn Brianne Catchments,
W89-01206 5C

Relationship Between Glacial Geology and Streamwater Chemistry in an Area Receiving Acid Deposition,
W89-01210 5B

Estimating Soil/Sediment Partition Coefficients for Organic Compounds by High Performance Reverse Phase Liquid Chromatography,
W89-01223 5B

Transport Modelling of Biological Tracers from Septic Systems,
W89-01226 5B

Binding of Heavy Metals to Algal Surfaces,
W89-01227 5B

Metallothionein-Like Heavy Metal Binding Protein Levels in Asiatic Clams Are Dependent on the Duration and Mode of Exposure to Cadmium,
W89-01228 5B

Fate and Transport of Organics in Soil: Model Predictions and Experimental Results,
W89-01239 5B

Time-Dependent Macrodispersion for Solute Transport in Anisotropic Heterogeneous Aquifers,
W89-01245 2F

Atmospheric Deposition of Polycyclic Aromatic Hydrocarbons to Water Surfaces: A Mass Balance Approach,
W89-01257 5B

Nitrate Trace Determinations in Snow and Firn Core Samples of Ice Shelves at the Weddell Sea, Antarctica,
W89-01258 5B

PATH OF POLLUTION

Comparison of Drinking Water Mutagenicity with Leaching of Polycyclic Aromatic Hydrocarbons from Water Distribution Pipes,
W89-00619 5C

PATH OF POLUTANTS

Three-Dimensional Radial Dispersion in a Variable Velocity Flow Field,
W89-00715 5B

PATHOGENS

Microbial Characterization of Municipal Wastewater at a Spray Irrigation Site: the Lubbock Infection Surveillance Study,
W89-01124 7B

PEAK DISCHARGE

Drainage Basin Peak Discharge Rating Curve,
W89-00913 2E

PEAK FLOW

Flow Capacity of Culverts on Oregon Coast Range Forest Roads,
W89-00878 8B

PEARSON DISTRIBUTION

Generalized Method of Moments Applied to LP3 Distribution,
W89-00901 2E

Application of Probability Weighted Moments in Estimating the Parameters of the Pearson Type Three Distribution,
W89-01198 7C

PEARSON DISTRIBUTIONS

Confidence Intervals for Flood Events Under a Pearson 3 or Log Pearson 3 Distribution,
W89-00879 7C

Determination of Probability Weighted Moments with the Incorporation of Extraordinary Values into Sample Data and Their Application to Estimating Parameters for the Pearson Type Three Distribution,
W89-01199 7C

PEAT

Multi-Component Sorption Isotherms of Basic Dyes onto Peat,
W89-00083 5D

Peat Accumulation and the Success of Marsh Plants,
W89-00909 2H

PEAT BOGS

Changes in Phytoplankton Over a Ten-Year Period in a Lake Undergoing De-Eutrophication due to Surrounding Peat Bogs,
W89-00196 2H

Cycling of Inorganic and Organic Sulfur in Peat from Big Run Bog, West Virginia,
W89-00208 2H

Development of Streamlined Bog Islands in the Continental Interior of North America,
W89-00434 2H

Decomposition in an Ombrotrophic Bog and a Minerotrophic Fen in Minnesota,
W89-00742 2H

Evaluating Peat-Mining Hydrology Using DRAINMOD,
W89-00755 4C

PEAT SOIL

Peatland Soil-Plant Relationships in the New Forest,
W89-00122 2H

PEAT SOILS

Runoff Generation in a Plough-drained Peat Bog in Southern Scotland,
W89-00345 4C

PEATLANDS

Effects of Disturbances Along Hydroelectrical Transmission Corridors Through Peatlands in Northern Manitoba, Canada.
W89-00436 4C

PENNSYLVANIA

Unionid (Mollusca:Bivalvia) Fauna of the Shenango River in Mercer County, Pennsylvania,
W89-00312 5C

Baseline Study of Jordan Creek, City of Allentown, Lehigh County, Pennsylvania,
W89-00313 5C

Simulation of Regional Ground Water Flow in Bedrock, Southwestern New York-Northwestern Pennsylvania,
W89-00882 2F

PENSACOLA BAY

Creosote Compounds in Snails Obtained from Pensacola Bay, Florida, near an Onshore Hazardous-Waste Site,
W89-00611 5B

PENTACHLOROPHENOL

Study of the Temperature Dependence of the Acute Toxicity of Pentachlorophenol to a Freshwater Pond Snail, Viviparus bengalensis L.,
W89-00078 5C

Removal of Pentachlorophenol in Municipal Activated Sludge Systems,
W89-00509 5D

Creosote Compounds in Snails Obtained from Pensacola Bay, Florida, near an Onshore Hazardous-Waste Site,
W89-00611 5B

PERDIDO KEY

Hurricane-Related Morphodynamics and Implications for Hazard Mitigation, Perdido Key, Florida, U.S.A.,
W89-00291 6B

PERFORMANCE EVALUATION

Evaluation of the Reliability of Wave-Protection Slab Revetments of Embankment Slopes,
W89-01176 8D

PERIPHYTON

Periphyton, Benthic Invertebrates and Fishes as Biological Indicators of Water Quality in the East Branch Brandywine Creek,
W89-00314 5A

Impact of a Municipal Wastewater Effluent on Water Quality, Periphyton, and Invertebrates in the Little Miami River Near Xenia, Ohio,
W89-00685 5C

PERMEABILITY COEFFICIENT

Effect of Assumed Unit Gradient During Drainage on the Determination of Unsaturated Hydraulic Conductivity and Infiltration Parameters,
W89-00407 2G

PESTICIDE TOXICITY

Pesticidal Effects on Chironomid Larvae,
W89-00079 5C

Biochemical Changes in the Liver of Fish, Tilapia mossambica (Peters), during Continuous Exposure to Monocrotophos,
W89-00085 5C

Toxicity Bioassay of Technical and Commercial Formulations of Carbaryl to the Freshwater Catfish, Clarias batrachus,
W89-00086 5C

Investigations of the Ecotoxicological Effect of an Herbicide in an Aquatic Model Ecosystem:

II. Food Chain Significance and Pesticide Balance (Untersuchungen zur okotoxikologischen Wirkung eines Herbizids in einem aquatischen Modellokosystem: II. Nahrungskettenprobleme und Schadstoffbilanzierung),
W89-00175 5C

Pesticides: A Continuing Dilemma,
W89-01122 5B

PESTICIDES

Growth and Conversion Efficiency of the Catfish Heteropneustes fossilis (Bloch) Exposed to Sub-Lethal Concentrations of Sodium Pentachlorophenate,
W89-00243 5C

Estimate of the Variability in Biotransformation Kinetics of Xenobiotics in Natural Waters by Aufwuchs Communities,
W89-00559 5B

Determination of Phenoxy Acid Herbicides in Water Samples,
W89-00576 5A

Effects of Lindane and Atropine Sulphate on the Tissues of the Fish, Anabas testudineus (Bloch): A Chronotoxicological Approach,
W89-00594 5C

Analysis of Atrazine in Underground Waters at Part Per Trillion Levels as an Early Warning Method for Contamination and for Soil Distribution Studies,
W89-00596 5A

Biotic and Abiotic Degradation Rates of Methyl Parathion in Freshwater and Estuarine Water and Sediment Samples,
W89-00601 5B

Long-term Study of Ecosystem Contamination with 2,3,7,8-Tetrachlorodibenzo-p-dioxin,
W89-00603 5B

Chlorinated Hydrocarbons in Sediments of the Elbe River and the Elbe Estuary,
W89-00614 5B

Induced Resistance to Polychlorinated Biphenyls Confers Cross-Resistance and Altered Environmental Fitness in a Marine Diatom,
W89-00860 5C

Treatment of Herbicides in Ground Water,
W89-00938 5F

Contamination of Farmstead Wells by Pesticides, Volatile Organics, and Inorganic Chemicals in Kansas,
W89-00946 5B

Encapsulated Herbicides Could Curb Ground Water Pollution,
W89-00964 5G

Problem with Nitrates,
W89-00965 5B

Acute and Chronic Toxicity of Triphenyltin Hydroxide to Fathead Minnows (Pimephales promelas) Following Brief or Continuous Exposure,
W89-01057 5C

Determination of Thiram in Water and Soils by Cathodic Stripping Voltammetry Based on Adsorptive Accumulation,
W89-01087 5A

Pesticides: A Continuing Dilemma,
W89-01122 5B

Branchial and Renal Pathology in the Fish Exposed Chronically to Methoxy Ethyl Mercuric Chloride,
W89-01156 5C

Sorption and Degradation of Aldicarb and Its Oxidation Products in a Soil-Water Flow System as a Function of pH and Temperature,
W89-01164 5B

PHAEOPHYTA

Population Dynamics of a Tropical Intertidal and Deep-Water Population of Sargassum polyceratium (Phaeophyceae),
W89-00528 2L

PHENOLS

Avoidance of a Water-Soluble Fraction of Coal Liquid by Fathead Minnows,
W89-00321 5C

Immobilization of Leachable Toxic Soil Pollutants by Using Oxidative Enzymes,
W89-00341 5G

Sublethal Effects of Chlorinated Phenols and Resin Acids on Rainbow Trout (Salmo gairdneri),
W89-00364 5C

Simultaneous Gas Chromatographic Determination of Nitrobenzene and 2,4-Dinitrophenol in Nitrobenzene Manufacturing Plant Wastewater,
W89-00479 5A

Evaluation of Aquatic Environmental Fate of 2,4,6-Trichlorophenol with a Mathematical Model,
W89-00616 5B

Terrestrial Bioaccumulation Potential of Phenolic Compounds,
W89-00998 5B

PHOSPHATES

Increased Phytoplankton Primary Production in the Marsdiep Area (Western Dutch Wadden Sea),
W89-00674 5C

Phosphorus Determination in Rivers (Phosphor in Fliessgewaessern und Seine Analytische Bestimmung),
W89-00735 5A

Fish, Fleas and Phytoplankton,
W89-00851 5C

Determination of Phosphate at Low Concentrations in Surface Waters by Flow-Injection Analysis,
W89-00931 5A

PHOSPHORUS

Availability of Phosphorus Sources for Blooms of Phaeocystis pouchetii (Haptophyceae) in the North Sea: Impact of the River Rhine,
W89-00004 2L

Lake Restoration: Why Oxygenation and Artificial Mixing Cannot Substitute for a Decrease in the External Phosphorus Loading,
W89-00015 5G

Chemical Methods of P-Elimination in the Tributaries of Reservoirs and Lakes,
W89-00020 5G

Leaf Production and Nitrogen and Phosphorus Tissue Content of Littorella uniflora (L.) Aschers. in Relation to Nitrogen and Phosphorus Enrichment of the Sediment in Oligotrophic Lake Hampen, Denmark,
W89-00101 5C

Nitrogen, Phosphorus and Potassium in Salvinia molesta Mitchell in the Field: Effects of Weather, Insect Damage, Fertilizers and Age,
W89-00113 2H

Nutrient Dynamics in Minerotrophic Peat Mires,
W89-00119 2H

Effects of Acidification and Phosphorus Addition on Phytoplankton Biomass and Productivity in a Circum-Neutral Mesotrophic Lake Receiving Acid Precipitation,
W89-00179 2H

Characteristics of Distribution and Migration of Phosphorus in Deposits of Dianchi Lake, (in Chinese),
W89-00200 5B

Nitrogen and Phosphorus Balance in Lake Szczytno Male,
W89-00240 2H

Concentrations of Nitrogen and Phosphorus in Waters of Two Hypertrophic Lakes and Their Effect on the Quantity of Phytoplankton Biomass,
W89-00245 2H

Diurnal Fluctuations of Phosphorus Forms in Lake Water and Seston in Pluss-See,
W89-00246 2H

Chlorophyll Relationships in Letowo and Szczytno Male Lakes, with Trout Cage Culture,
W89-00262 2H

Exchange of Phosphorus between a Euhaline Vegetated Marsh and the Adjacent Tidal Creek,
W89-00283 5B

Sequential Extraction of Phosphorus and Heavy Metals from Sediments: Methodological Considerations,
W89-00629 5A

Phosphorus Determination in Rivers (Phosphor in Fliessgewaessern und Seine Analytische Bestimmung),
W89-00735 5A

Spatial Patchiness in the Lacustrine Sedimentary Environment,
W89-01048 2H

Assessing Effects of Soil Pollution Control Residuals on Soil Chemistry Properties,
W89-01140 5E

Lake Response Modeling Using Biologically Available Phosphorus,
W89-01236 5C

Factors Affecting the Efficiency of Some Estimates of Fluvial Total Phosphorus Load,
W89-01249 5B

PHOSPHORUS COMPOUNDS

Strategies of Lake Sanitation,
W89-00017 5G

Phosphorus Determination in Rivers (Phosphor in Fliessgewaessern und Seine Analytische Bestimmung),
W89-00735 5A

PHOSPHORUS FERTILIZATION

Background Aspects of Lake Restoration: Water Balance, Heavy Metal Content, Phosphorus Homeostasis,
W89-00014 2H

PHOSPHORUS REMOVAL

Phosphorus Removal by Crystallization Using a Granular Activated Magnesia Clinker,
W89-01126 5D

PHOTODEGRADATION

Evaluation of Aquatic Environmental Fate of 2,4,6-Trichlorophenol with a Mathematical Model,
W89-00616 5B

Studies of the Oxidative Photoinduced Degradation of Silicones in the Aquatic Environment,
W89-00617 5B

PHOTOLYSIS
Photochemical Reaction of Biphenyl in Water Containing Nitrite or Nitrate Ion,
W89-00593 5B

PHOTOSYNTHESIS
Hypolimnetic Chlorophyll Maximum by Algae and Sulphur Bacteria in one Eutrophic Pond,
W89-00012 2H

Photosynthesis of Submersed Macrophytes in Acidified Lakes: II. Carbon Limitation and Utilization of Benthic CO2 Sources,
W89-00095 5C

Model of Zostera marina L. Photosynthesis and Growth: Simulated Effects of Selected Physical-Chemical Variables and Biological Interactions,
W89-00130 2L

Effect of 3,4 Benzopyrene on the Photosynthetic and Respiratory Intensity of the Green Alga Scenedesmus quadricauda (Der Einfluss von 3,4-Benzpyren aud die Photosynthese- une Respirationsintensitat der Gruenalge Scenedesmus quadricauda),
W89-00135 5C

Quantum Yield as a Fundamental Parameter Controlling Vertical Photosynthetic Profiles of Phytoplankton in Lake Constance,
W89-00176 2H

Effect of Light Regime upon Growth Rate and Chemical Composition of a Clone of Skeletonema costatum from the Trondheimsfjord, Norway,
W89-00212 2L

Measurement of Primary Productivity in a High-Rate Oxidation Pond (HROP),
W89-00213 2H

Short-term Dynamics of a Melosira Population in the Plankton of an Impoundment in Central Chile,
W89-00214 2H

Clouds, Deep Chlorophyll Maxima and the Nutrient Supply to the Mixed Layer of Stratified Water Bodies,
W89-00227 2L

Benthic Chamber for Use in Rivers: Testing against Oxygen Mass Balances,
W89-00488 7B

Method to Assess Periodic Responses of Aquatic Microecosystems to Photosynthetic Inhibition,
W89-00562 7B

Effects of Light and Temperature on Photosynthesis of the Nuisance Alga Cladophora glomerata (L.) Kutz from Green Bay, Lake Michigan,
W89-00848 2H

PHOTOSYNTHETIC BACTERIA
Hypolimnetic Chlorophyll Maximum by Algae and Sulphur Bacteria in one Eutrophic Pond,
W89-00012 2H

Photoexcretion and Fate of Glycolate in a Hot Spring Cyanobacterial Mat,
W89-00342 2H

PHYSICAL PROPERTIES
Nonaqueous Phase Liquid Transport and Cleanup: I. Analysis of Mechanisms,
W89-00968 5B

PHYSICOCHEMICAL PROPERTIES
Physicochemical and Geotechnical Characteristics of Recent Saguenay Fjord Sediments,
W89-00390 2J

PHYSIOLOGICAL ECOLOGY
Interspecific, Seasonal and Diel Variations in Zooplankton Trypsin and Amylase Activities in Kosterfjorden, Western Sweden,
W89-01040 2L

PHYTOCENOSES
Differentiation of the Physical and Chemical Properties of Bottom Sediments in Phytocenoses of Myriophylletum verticillati Soo 1927, Potamogetonetum natantis Soo 1927 and Hydrocharitetum morsus-ranae Langendonck 1935 Associations,
W89-00259 2H

PHYTOPLANKTON
Phytoplankton Composition of Stagnant and Tidal Ecosystems in Relation to Salinity, Nutrients, Light and Turbulence,
W89-00001 2L

Availability of Phosphorus Sources for Blooms of Phaeocystis pouchetii (Haptophyceae) in the North Sea: Impact of the River Rhine,
W89-00004 2L

Hypolimnetic Chlorophyll Maximum by Algae and Sulphur Bacteria in one Eutrophic Pond,
W89-00012 2H

Response of Phytoplankton Communities to Changing Lake Environments,
W89-00018 2H

Seasonal Productivity Cycle of Phytoplankton and Controlling Factors in Lake Constance,
W89-00022 2H

Simple Self-Acting Hydrobiological Sampler (Prosty samoczynny czerpacz hydrobiologiczny),
W89-00033 7B

Seasonal Composition, Biomass and Primary Productivity of the Phytoplankton in Lakitelek Backwater during 1980 and 1983,
W89-00144 2H

Seasonal Changes of Phytoplankton in the Backwater Bokros,
W89-00147 2H

Modelling Research on the Production Cycle of Phytoplankton in the Southern Bight of the North Sea in Relation to Riverborne Nutrient Loads,
W89-00157 2L

Use of Plant Micro-Nutrient and Chlorophyll Records as Indices of Eutrophication in Inshore Waters,
W89-00160 5A

Effect of the Hydrological Regime on Primary Production in the Main Stream and the Side Arms of the River Danube,
W89-00162 2H

Seasonal Fluctuations in the Species Composition of Phytoplankton and Phytobenthos in the Lobau Near Vienna (Jahreszeitliche Schwankungen in der Zusammensetzung des Phytoplanktons und Phytobenthos in Altwassern der Lobau bei Wien),
W89-00166 2H

Phytoplankton Studies of Slowly Running Waters: Rivers Danube and Vils (Phytoplanktonstudien an langamfliessenden Gewassern: Donau und Vils),
W89-00172 2E

Quantum Yield as a Fundamental Parameter Controlling Vertical Photosynthetic Profiles of Phytoplankton in Lake Constance,
W89-00176 2H

Effects of Acidification and Phosphorus Addition on Phytoplankton Biomass and Productivity in a Circum-Neutral Mesotrophic Lake Receiving Acid Precipitation,
W89-00179 2H

Factors Affecting Nutrient Dynamics in a Piedmont North Carolina Reservoir,
W89-00187 2H

Biochemical Models for the Hypolimnetic Oxygen Depletion in Lakes Impacted by Wastewater Discharges: 2. Phytoplankton Biomass Model,
W89-00189 5C

Changes in Phytoplankton Over a Ten-Year Period in a Lake Undergoing De-Eutrophication due to Surrounding Peat Bogs,
W89-00196 2H

Short-term Dynamics of a Melosira Population in the Plankton of an Impoundment in Central Chile,
W89-00214 2H

Nitrogen Dynamics in Lower Narragansett Bay: II. Phytoplankton Uptake, Depletion Rates of Nitrogenous Nutrient Pools, and Estimates of Ecosystem Remineralization,
W89-00215 2L

Body Size and Mass Flow in Freshwater Plankton: Models and Tests,
W89-00218 2H

Spatial and Temporal Distribution Patterns of Three Trophic Levels in a Saline Lake,
W89-00219 2H

Summer Dynamics of the Deep Chlorophyll Maximum in Lake Tahoe,
W89-00224 2H

Bacterial Response to Seasonal Changes in Primary Production and Phytoplankton Biomass in Lake Constance,
W89-00225 2H

Nitrate Reductase Activity in Phytoplankton from the Oslo-fjord, Norway,
W89-00226 2H

Nitrate and Ammonium Uptake by Plankton in an Amazon River Floodplain Lake,
W89-00229 2H

Regeneration and Uptake of Ammonium by Plankton in an Amazon Floodplain Lake,
W89-00230 2H

Effects of Increasing Salinity on a Cyanobacteria Bloom in the Potomac River Estuary,
W89-00231 2H

Role of Storms in the Summer Succession of the Phytoplankton Community in a Shallow Lake (Lake Balaton, Hungary),
W89-00232 2H

Sedimentation of Phytoplankton Populations Dominated by Microcystis in a Shallow Lake,
W89-00233 2H

Concentrations of Nitrogen and Phosphorus in Waters of Two Hypertrophic Lakes and Their Effect on the Quantity of Phytoplankton Biomass,
W89-00245 2H

Effect of Witobelskie and Lodzko-Dymaczewskie Lakes on Phytoplankton of Samica Steszewska River,
W89-00247 2H

PHYTOPLANKTON

Estimation of Phytoplankton Biomass and Production, and Organic Matter Decomposition in Three Small Field-Ponds,
W89-00252 2H

Changes in Chlorophyll Contents of Swietokrzyskie Lake Phytoplankton, as Related to Qualitative and Quantitative Fluctuations of Phytoplankton Density and of the Physicochemical Conditions in this Lake in Summer 1979,
W89-00257 5C

Qualitative and Quantitative Changes in Phytoplankton on the Background of Physicochemical Changes in the Water of Swietokrzyskie Lake in the Years 1977-1979,
W89-00258 5C

Increased Phytoplankton Primary Production in the Marsdiep Area (Western Dutch Wadden Sea),
W89-00674 5C

Algal Studies of the River Ely, South Wales, U.K.: I. Phytoplankton,
W89-00678 2H

Impact of a Municipal Wastewater Effluent on Water Quality, Periphyton, and Invertebrates in the Little Miami River Near Xenia, Ohio,
W89-00685 5C

Effects of Current Velocity on the Physical Structuring of Diatom (Bacillariophyceae) Communities,
W89-00686 2E

Vertical Distribution of Phytoplankton in a Stratified Lake (Lago Dom Helvecio, Southeastern Brazil) with Special Reference to the Metalimnion,
W89-00768 2H

Utilization of Nitrogenous Nutrients by Natural Phytoplankton in Enriched Lake Waters,
W89-00773 2H

Hydrography and Plankton of the Moray Firth,
W89-00778 2L

Seasonal Studies on the Phytoplankton and Primary Production in the Inner Firth of Clyde,
W89-00812 2L

Phytoplankton Ecology of the Firth of Clyde Sea-Lochs Striven and Fyne,
W89-00813 2L

Fish, Fleas and Phytoplankton,
W89-00851 5C

Seasonal Phytoplankton Demographic Processes and Experiments on Interspecific Competition,
W89-00906 2H

Primary Production in the Orinoco River,
W89-00907 2H

Manganese Oxidation in pH and O2 Microenvironments Produced by Phytoplankton,
W89-01045 2K

Phytoplankton and Reversed Eutrophication in Lake Malaren, Central Sweden, 1965-1983,
W89-01188 5G

PHYTOTOXICITY

Possible Mechanism for Manganese Phytotoxicity in Hawaii Soils Amended with a Low-Manganese Sewage Sludge,
W89-01169 5E

PIEZOMETERS

Finite Element Computation of Shape Factors for Kirkham's Piezometer Tube Method for Hydraulic Conductivity of Saturated Soil,
W89-00911 2G

Tracer Test Analysis of Anisotropy in Hydraulic Conductivity of Granular Aquifers,
W89-00940 2F

PIGMENTS

Comparison of Methods for the Determination of Chlorophyll in Estuarine Sediments,
W89-00668 2L

Spatial Patchiness in the Lacustrine Sedimentary Environment,
W89-01048 2H

PILES

Cities Supported by Sticks in the Mud: A Variation on the Settlement of Land and Structures Caused by Ground Water Removal,
W89-01190 6E

PIPE FLOW

Pipe Flow in James Bay Coastal Wetlands,
W89-00047 2A

PIPELINES

Technology of Casting Precast Pipeline Elements of the Kaisiadory's Pumped-Storage Station,
W89-00045 8F

Subsoil Investigation of Ice Lensing at the Calgary, Canada, Frost Heave Test Facility,
W89-00389 2C

PIPES

Comparison of Drinking Water Mutagenicity with Leaching of Polycyclic Aromatic Hydrocarbons from Water Distribution Pipes,
W89-00619 5C

Performance of Buried Small Pipes,
W89-00754 8A

PIT RECHARGE

In-Situ Method for Monitoring Layered Hydraulic Impedance Development During Artificial Recharge with Turbid Water,
W89-01205 2F

PLAICE

Distribution of Plaice Eggs and Larvae in the Clyde Sea Area,
W89-00829 2L

PLANKTON

Microbiological Examination of the Carska Bara Swamp Water,
W89-00146 2H

Environmental Conditions in Abu Kir Bay, East of Alexandria: II. Plankton Distribution, Downstream from Land-Based Effluents,
W89-00578 5C

Influence of Chemicals upon Plankton in Freshwater Systems,
W89-00581 5C

Clearance of Bacteria-Sized Particles by Natural Populations of Nanoplankton in the Chesapeake Bay Outflow Plume,
W89-01032 2L

PLANNING

Hurricane-Related Morphodynamics and Implications for Hazard Mitigation, Perdido Key, Florida, U.S.A.,
W89-00291 6B

Programming Model for the Optimal Planning of Water Supply Systems,
W89-00452 6A

Maximally Informative Environmental Control Policies for Natural Resource Systems with Probabilistic Constraints,
W89-00458 6A

Remote Sensing Applications in Water Resource Prospecting and Management,
W89-00459 7B

Innovative Septic System Management,
W89-00508 5D

Identifying Critical Issues in Recreation Planning and Management: Improving the Management-Research Partnership,
W89-00873 6A

Developing and Assessing a Model of Residential Water Conservation,
W89-00881 3D

PLANT GROWTH

Influence of Sediment Composition and Irradiance on the Growth and Morphology of Myriophyllum spicatum L.,
W89-00098 2H

Leaf Production and Nitrogen and Phosphorus Tissue Content of Littorella uniflora (L.) Aschers. in Relation to Nitrogen and Phosphorus Enrichment of the Sediment in Oligotrophic Lake Hampen, Denmark,
W89-00101 5C

Correlations between Salinity and Growth of the Seagrass Amphibolis antarctica (Labill.) Sonder & Aschers., in Shark Bay, Western Australia, Using a New Method for Measuring Production Rate,
W89-00102 2L

Equations Relating Growth and Uptake of Nitrogen by Salvinia molesta to Temperature and the Availability of Nitrogen,
W89-00111 2H

Effect of Sediment Depth and Sediment Type on the Survival of Vallisneria americana Michx Grown from Tubers,
W89-00114 2H

Effects of Light Intensity on Growth of Azolla pinnata Cultured in Effluent Collected from the Banka Stream in West Bengal, India,
W89-00127 5C

Growth Strategies and Distribution of Isoetids in Scottish Freshwater Lochs,
W89-00129 5C

Model of Zostera marina L. Photosynthesis and Growth: Simulated Effects of Selected Physical-Chemical Variables and Biological Interactions,
W89-00130 2L

Tisza Water, as Irrigation Water, Polluted with Various Compounds,
W89-00145 3C

Roles of Sedimentation and Plant Growth in Changing Flow Patterns in the Okavango Delta, Botswana,
W89-00457 2J

Does Transpiration Limit the Growth of Vegetation or Vice Versa,
W89-01013 2I

PLANT MORPHOLOGY

SEM-Analysis of Colonies of the Cyanophyte Nodularia Water Bloom from Baltic Sea,
W89-00193 2H

PLANT PHYSIOLOGY

Carbon Source of the Water Soldier, Stratiotes aloides L.,
W89-00128 2H

PLANT PIGMENTS

Comparison of Methods for the Determination of Chlorophyll in Estuarine Sediments,
W89-00668 2L

PLANT VIRUSES
Mechanism of Inactivation of Tobacco Mosaic Virus with Ozone,
W89-01229 5F

PLASMIDES
Contribution of Plasmids to Naphthalene Catabolism in Sediment Bacteria,
W89-00378 5B

PLASMIDS
Conjugal Transfer of R68.45 and FP5 between Pseudomonas aeruginosa Strains in a Freshwater Environment,
W89-00728 5B

PLASTIC PIPES
Performance of Buried Small Pipes,
W89-00754 8A

PLASTICS
Manufacture of Polyethylene Seals for High-head Gates of Hydraulic Structures,
W89-00043 8G

Technology of Casting Precast Pipeline Elements of the Kaisiadory's Pumped-Storage Station,
W89-00045 8F

PLOTTING POSITIONS
Location-Invariant Plotting Positions for PWM Estimation of the Parameters of the GEV Distribution,
W89-00351 2E

PLUMES
River-Forced Estuarine Plumes,
W89-00414 2L

Three-Dimensional Radial Dispersion in a Variable Velocity Flow Field,
W89-00715 5B

Contaminant Transport in Fractured Porous Media: Steady State Solutions by a Boundary Integral Method,
W89-00982 5B

PLYAVINYAS HYDROELECTRIC PLANT
Some Results of Investigating the State of the Powerhouse of the Plyavinyas Hydroelectric Station,
W89-01180 8D

PO RIVER
Trophic State Gradients and Zooplankton and Zoobenthos Distribution in a Po River Delta Lagoon,
W89-00580 2L

POLAND
Influence of Dusts from Chosen Industrial Plants on Particular Links of Forest Ecosystem of the Niepolomice Forest,
W89-00081 5C

Chemistry of Atmospheric Precipitation in the Babia Gora National Park,
W89-00082 5B

Habitat Requirements and Bioindicator Value of the Main Communities of Aquatic Vegetation in North-East Poland,
W89-00235 2H

Indicatory Role of Some Invertebrates for Quality of Water in the Vistula River and in Subsequent Stages of Its Treatment,
W89-00236 5A

Chemical Characteristics of Bottom Sediment Top Layer in Szczytno Male Lake,
W89-00237 2H

Effect of Witobelskie and Lodzko-Dymaczewskie Lakes on Phytoplankton of Samica Steszewska River,
W89-00247 2H

Influence of the Vistula River on Distribution of 226Ra in the Gdansk Bay,
W89-00250 2K

Chemical Mechanisms of Heavy Metal Transport in Waters of Mala Panew and Brynica Rivers (Silesia, Poland),
W89-00251 5B

Contemporary Changes in Coastal Biocenoses of the Gdansk Bay (South Baltic), A Review,
W89-00254 2L

Sorption Properties of Bottom Sediments of Szczytno Male and Letowo Lakes,
W89-00256 2H

Changes in Chlorophyll Contents of Swietokrzyskie Lake Phytoplankton, as Related to Qualitative and Quantitative Fluctuations of Phytoplankton Density and of the Physicochemical Conditions in this Lake in Summer 1979,
W89-00257 5C

Qualitative and Quantitative Changes in Phytoplankton on the Background of Physicochemical Changes in the Water of Swietokrzyskie Lake in the Years 1977-1979,
W89-00258 5C

Differentiation of the Physical and Chemical Properties of Bottom Sediments in Phytocenoses of Myriophylletum verticillati Soo 1927, Potamogetonetum natantis Soo 1927 and Hydrocharitetum morsus-ranae Langendonck 1935 Associations,
W89-00259 2H

Effect of Drainage Basin on Heavy Metal Concentrations in Stream Waters in the Niepolomice Forest,
W89-00260 5B

POLAROGRAPHY
Determination of Trace Chromium in Natural Water by Polarographic Catalytic Wave Analysis, (in Chinese),
W89-00538 5A

POLICY MAKING
Maximally Informative Environmental Control Policies for Natural Resource Systems with Probabilistic Constraints,
W89-00458 6A

Remote Sensing Applications in Water Resource Prospecting and Management,
W89-00459 7B

Coastal Management Issues for the Mouth of the River Murray, South Australia,
W89-01072 6E

POLITICAL ASPECTS
Politics of Hydro-Megaprojects: Damming with Faint Praise in Australia, New Zealand, and British Columbia,
W89-00836 6E

Clean Air Act-Transboundary Acid Rain Pollution Abatement-Administrative Discretion Citizen Suit,
W89-00839 5G

Interjurisdictional Management in Chesapeake Bay Fisheries,
W89-01073 6E

POLLUTANT IDENTIFICATION
Use of Mires in Monitoring the Atmospheric Deposition of Heavy Metals,
W89-00123 5A

Isotope Ratio Measurements of Mo, V, Ti, and Zr and the Determination of These Elements in Water Samples with a Thermal Ionization Quadrupole Mass Spectrometer (Isotopenverhaltnismessung von Mo, V, Ti and Zr Sowie Deren Konzentrationsbestimmung in Wassern Mit Einem Thermionen-Quadrupol-Massenspektrometer),
W89-00267 5A

Chromium Trace Determination in Inorganic, Organic and Aqueous Samples with Isotope Dilution Mass Spectrometry (Chromspurenbestimmungen in Anorganischen, Organischen und wa-Brigen Proben mit der Massenspektrometrischen Isotopenverdunnungsanalyse),
W89-00268 5A

Determination of Nitrate at the Ng/g Level in Antarctic Snow Samples with Ion Chromatography and Isotope Dilution Mass Spectrometry,
W89-00269 5A

Determination of Heavy Metals at the Pg/g Level in Antarctic Snow with DPASV and IDMS,
W89-00270 5A

Chernobyl 134Cs, 137Cs, and 210Pb in High Mountain Lake Sediment: Measurements and Modeling of Mixing Process,
W89-00271 5B

Wound Fiberglass Depth Filters as a Less Expensive Approach for the Concentration of Viruses from Water,
W89-00279 5A

Analysis of ppb Levels of Organics in Water by Means of Purge-and-Trap, Capillary Gas Chromatography and Selective Detectors,
W89-00288 5A

Efficacy of Chemical Dosing Methods for Isolating Nontuberculous Mycobacteria from Water Supplies of Dialysis Centers,
W89-00343 5A

Methods for Determination of Sum Parameters and Characterization of Organochlorine Compounds in Spent Bleach Liquors from Pulp Mills and Water, Sediment and Biological Samples from Receiving Waters,
W89-00358 5A

Fate of Spent Bleach Liquor Material in Receiving Waters: Characterization of Chloroorganics in Sediments,
W89-00371 5B

Determination of Mono- and Divalent Cations and Anions in Small Fog Samples by Ion Chromatography,
W89-00372 5A

Atmospheric Deposition of Arsenic and Association with Acid Precipitation,
W89-00431 5B

Short-Term Trends in Sulfate Deposition at Selected Bulk Precipitation Stations in New York,
W89-00432 5B

Purge and Trap Analysis of Aqueous Samples with Cryofocusing,
W89-00446 5A

Determination of Free Cyanide in Water by Released Fluorescence of a Dissociated Ternary Complex,
W89-00477 5A

Simultaneous Gas Chromatographic Determination of Nitrobenzene and 2,4-Dinitrophenol in Nitrobenzene Manufacturing Plant Wastewater,
W89-00479 5A

Determination of Cobalt Ions in Natural Waters Using Differential Pulse Adsorptive Stripping Voltammetry,
W89-00480 5A

POLLUTANT IDENTIFICATION

Indirect Trace Determination of Ethylenediaminetetraacetic Acid (EDTA) in Water by Potentiometric Stripping Analysis,
W89-00481 5A

Determination of Traces of Bismuth in Water with Polyurethane Foam Thin-Layer Spectrophotometry,
W89-00482 5A

Head-Space Analysis of Readily Volatile Chlorinated Hydrocarbons in Air and Water (Head-Space-Analytik Leichtfluechtiger Chlorkohlenwasserstoffe in Luft und Wasser),
W89-00504 5A

Preconcentration of Heavy Metals in Natural Waters with Hydrazones Supported on Silica Gel,
W89-00568 5A

Application of Headspace Gas Chromatography to the Monitoring of Organic Substances in Industrial Effluent,
W89-00572 5A

High Resolution Emission Spectroscopy (Shpol'skii Effect): A New Analytical Technique for the Analysis of Polycyclic Aromatic Hydrocarbons (PAH) in the Environmental Samples,
W89-00574 5A

Determination of Phenoxy Acid Herbicides in Water Samples,
W89-00576 5A

Determination of Total Organic Chlorine and Bromine in Water Samples by Adsorption onto Activated Carbon and Neutron Activation Analysis,
W89-00588 5A

Determination of Polychlorinated Dibenzofurans in Surface Water by Means of Liquid Chromatography Using on-Line Sample Preconcentration and Different Spectroscopic Detection Techniques,
W89-00590 5A

Analysis of Atrazine in Underground Waters at Part Per Trillion Levels as an Early Warning Method for Contamination and for Soil Distribution Studies,
W89-00596 5A

Routine Determination of Polychlorinated Biphenyl Residues in Fish and Shellfish in Taipei County,
W89-00605 5A

Sequential Extraction of Phosphorus and Heavy Metals from Sediments: Methodological Considerations,
W89-00629 5A

Polyethylene Glycol Precipitation for Recovery of Pathogenic Viruses, Including Hepatitis A Virus and Human Rotavirus, from Oyster, Water, and Sediment Samples,
W89-00730 5A

Comparison of Bacterial Indicators and Sampling Programs for Drinking Water Systems,
W89-00733 5A

Rapid Detection of Total and Fecal Coliforms in Water by Enzymatic Hydrolysis of 4-Methylumbelliferone-beta-D-Galactoside,
W89-00734 5A

Evaluation of the Sulfur(IV) Catalyzed Autoxidation of Cobalt(II) in an Azide Containing Medium as a Means for the Determination of Sulfite in Precipitation,
W89-00736 5A

Negative Thermal Ionization Mass Spectrometry of Selenium: Part 1. Isotope Ratio Measurements and Determinations in Aquatic Systems with the Isotope Dilution Technique (Negative Thermionen-Massenspektrometrie von Selen: Teil 1. Isotopenverhaeltnismessungen sowie Konzentrationsbestimmungen in Aquatischen Systemen mit der Isotopenverduennungsanalyse),
W89-00737 5A

Determination of Substituted Aromatic Amines in Water and Sediment Samples,
W89-00738 5A

Determination of Organotins in Natural Waters by Toluene Extraction and Graphite Furnace AAS,
W89-00743 5A

Sediment Analysis: Lability of Selectively Extracted Fractions,
W89-00744 5A

Microbial Pollution of Well Water in Southeastern Minnesota,
W89-00887 5B

Activity Assessment in Drinking Water Bacteriology - A Comparison of Methods and Possibilities,
W89-00928 5A

Determination of Phosphate at Low Concentrations in Surface Waters by Flow-Injection Analysis,
W89-00931 5A

Use of Total Organic Carbon as an Indicator of Contamination from an Oil Refinery, South-Central Kansas,
W89-00942 5A

Screened Auger Sampling: The Technique and Two Case Studies,
W89-00945 5A

Gas Chromatographic-Mass Spectrometric Investigations on Lipophilic Anthropogenic Substances in Environmental Samples. II: A Splitter for the Simultaneous Detection of Capillary Gas Chromatograms by up to Four Different GC-Detectors,
W89-01086 5A

Comparing Headspace with Purge and Trap for Analysis of Volatile Priority Pollutants,
W89-01119 5A

Microcomputer-Based Measurement of Algal Fluorescence as a Potential Indicator of Environmental Contamination,
W89-01157 5A

Is Water a Relevant Sampling Medium for Toxic Chemicals: An Alternative Environmental Sensing Strategy,
W89-01162 5A

Review of the Use of XAD Resins to Concentrate Organic Compounds in Water,
W89-01215 5A

Gravimetric Measurement of Adsorption Parameters in Water Systems with a Quartz Spring Balance,
W89-01216 5A

Detection of Environmental Viruses in Sludge: Enhancement of Enterovirus Plaque Assay Titers with 5-Iodo-2'-Deoxyuridine and Comparison to Adenovirus and Coliphage Titers,
W89-01220 5A

POLLUTANTS

Distribution of Arsenic in the Sediments and Biota of Hilo Bay, Hawaii,
W89-00677 5B

Is Water a Relevant Sampling Medium for Toxic Chemicals: An Alternative Environmental Sensing Strategy,
W89-01162 5A

POLLUTION LOAD

Load Allocation for Toxics Using Monte Carlo Techniques,
W89-00514 5G

Accumulation of Polycyclic Aromatic Hydrocarbons in Acid Sensitive Lakes,
W89-01074 5B

Factors Affecting the Efficiency of Some Estimates of Fluvial Total Phosphorus Load,
W89-01249 5B

POLYCHAETES

Distribution, Dynamics and Productivity of a Colonizing (Polydora quadrilobata) and an Established (P. ligni) Polydorid Polychaete in Lake Grevelingen: An Enclosed Estuary in the SW Netherlands,
W89-00002 2H

POLYCHLORINATED BIPHENYLS

PCB-resistant Diatoms in the Hudson River Estuary,
W89-00284 5C

Waste Transformer Oil and PCB Toxicity to Rainbow Trout,
W89-00328 5C

Transient Liver Pathology in Patients Consuming Water from a Private Well Contaminated by PCBs from a Submersible Water Pump,
W89-00558 5C

Sedimentation of 74 PCB Congeners in the Upper Hudson River,
W89-00584 5B

Routine Determination of Polychlorinated Biphenyl Residues in Fish and Shellfish in Taipei County,
W89-00605 5A

Polychlorinated Biphenyls in the Kupa River, Croatia, Yugoslavia,
W89-00609 5B

Partitioning of Organochlorines Between Water, Particulate Matter and Some Organisms in Estuarine and Marine Systems of the Netherlands,
W89-00672 5B

Contamination of Surface Sediments of the Principal Rivers of Geneva Canton by Polychlorinated Biphenyls and DDT (Contamination des Sediments Superficiels des Principales Rivieres du Canton de Geneve par les Polychlorobiphenyles et DDT),
W89-00690 5B

Induced Resistance to Polychlorinated Biphenyls Confers Cross-Resistance and Altered Environmental Fitness in a Marine Diatom,
W89-00860 5C

Variations in Polychlorinated Biphenyl Congener Composition in Eggs of Mediterranean Water Birds in Relation to their Position in the Food Chain,
W89-01056 5B

Organochlorine and Mercury Residues in Wild Mink and Otter: Comparison with Fish,
W89-01093 5B

POLYCHLORINATED DIBENZOFURANS

Determination of Polychlorinated Dibenzofurans in Surface Water by Means of Liquid Chromatography Using on-Line Sample Preconcen-

tration and Different Spectroscopic Detection Techniques,
W89-00590 5A

Destruction of Polychlorinated Dibenzo-p-Dioxins and Dibenzofurans in Contaminated Water Samples Using Ozone,
W89-00606 5D

POLYCHORINATED BIPHENYLS
Sorption and Desorption Dynamics of Aroclor 1242 to Natural Sediment,
W89-00991 5B

POLYCYCLIC AROMATIC HYDROCARBONS
High Resolution Emission Spectroscopy (Shpol'skii Effect): A New Analytical Technique for the Analysis of Polycyclic Aromatic Hydrocarbons (PAH) in the Environmental Samples,
W89-00574 5A

Photo-induced Toxicity of Polycyclic Aromatic Hydrocarbons to Larvae of the Fathead Minnow (Pimephales promelas),
W89-00595 5C

Analysis of Halogenated Polycyclic Aromatic Hydrocarbons in Urban Air, Snow and Automobile Exhaust,
W89-00613 5B

Comparison of Drinking Water Mutagenicity with Leaching of Polycyclic Aromatic Hydrocarbons from Water Distribution Pipes,
W89-00619 5C

Atmospheric Deposition of Polycyclic Aromatic Hydrocarbons to Water Surfaces: A Mass Balance Approach,
W89-01257 5B

POLYCYCLIC HYDROCARBONS
Effects of High Levels of Polycyclic Aromatic Hydrocarbons on Sediment Physicochemical Properties and Benthic Organisms in a Polluted Stream,
W89-00589 5C

POLYETHYLENE GLYCOL
Polyethylene Glycol Precipitation for Recovery of Pathogenic Viruses, Including Hepatitis A Virus and Human Rotavirus, from Oyster, Water, and Sediment Samples,
W89-00730 5A

POLYMERS
Effective Coatings for Hydraulic Structures,
W89-00075 8G

Studies of the Oxidative Photoinduced Degradation of Silicones in the Aquatic Environment,
W89-00617 5B

Characterization of the Interaction Between Viruses and a Solid Polymeric Contact Disinfectant,
W89-00884 5F

POLYPHOSPHATES
Effects of Cyanide and Polyphosphates on Adsorption of Metals from Simulated and Real Mixed-Metal Plating Wastes,
W89-01219 5D

POLYURETHANE-FOAM THIN-LAYER SPECTROPHOTOMETRY
Determination of Traces of Bismuth in Water with Polyurethane Foam Thin-Layer Spectrophotometry,
W89-00482 5A

PONDING
Infiltration under Ponded Conditions: 2. Infiltration Equations Tested for Parameter Time-Dependence and Predictive Use,
W89-00740 2G

PONDS
Hypolimnetic Chlorophyll Maximum by Algae and Sulphur Bacteria in one Eutrophic Pond,
W89-00012 2H

Investigations of the Ecotoxicological Effect of an Herbicide in an Aquatic Model Ecosystem: II. Food Chain Significance and Pesticide Balance (Untersuchungen zur okotoxikologischen Wirkung eines Herbizids in einem aquatischen Modellokosystem: II. Nahrungskettenprobleme und Schadstoffbilanzierung),
W89-00175 5C

Estimation of Phytoplankton Biomass and Production, and Organic Matter Decomposition in Three Small Field-Ponds,
W89-00252 2H

Effects of Polyculture and Manure Fertilization on Water Quality and Heterotrophic Productivity in Macrobrachium rosenbergii Ponds,
W89-00327 8I

Effectiveness of an Urban Runoff Detention Pond-Wetlands System,
W89-00487 5G

Influence of Chemicals upon Plankton in Freshwater Systems,
W89-00581 5C

POPULATION DENSITY
Seasonal Abundance and Distribution of Drift Algae and Seagrasses in the Mid-Indian River Lagoon, Florida,
W89-00104 2L

POPULATION DYANAMICS
Benthic Macrofauna of the Bot River Estuary, South Africa, with a Note on Its Meiofauna,
W89-00660 2L

POPULATION DYNAMICS
Population Dynamics and Production of Chironomidae (Diptera) at 2 m depth in Lake Esrom, Denmark,
W89-00182 2H

Primary Studies on Population Dynamics of 3 Species of Cladocera (Waterflea) in Dianshan Lake, (in Chinese),
W89-00198 2H

Short-term Dynamics of a Melosira Population in the Plankton of an Impoundment in Central Chile,
W89-00214 2H

Nitrogen Dynamics in Lower Narragansett Bay: II. Phytoplankton Uptake, Depletion Rates of Nitrogenous Nutrient Pools, and Estimates of Ecosystem Remineralization,
W89-00215 2L

Recurrence of Daphnia rosea in Lake Tahoe: Analysis of a Population Pulse,
W89-00216 2H

Loss Processes Influencing Growth of Planktonic Bacterial Populations in Lake Constance,
W89-00217 2H

Spatial and Temporal Distribution Patterns of Three Trophic Levels in a Saline Lake,
W89-00219 2H

Zooplankton Community Grazing in a Hypertrophic Lake (Hartbeespoort Dam, South Africa),
W89-00220 2H

Rotifers of Warri River, Nigeria,
W89-00222 2H

Tintinnids and Other Microzooplankton - Seasonal Distributions and Relationships to Resources and Hydrography in a Maine Estuary,
W89-00223 2L

Summer Dynamics of the Deep Chlorophyll Maximum in Lake Tahoe,
W89-00224 2H

Effects of Increasing Salinity on a Cyanobacteria Bloom in the Potomac River Estuary,
W89-00231 2H

Role of Storms in the Summer Succession of the Phytoplankton Community in a Shallow Lake (Lake Balaton, Hungary),
W89-00232 2H

Sedimentation of Phytoplankton Populations Dominated by Microcystis in a Shallow Lake,
W89-00233 2H

Structure of a Population of Lobelia dortmanna L. Along a Gradient of Increasing Depth in an Oligotrophic Lake,
W89-00525 2H

Seasonal Development of Lobelia Dortmanna L. and Annual Balance of Its Population Size in an Oligotrophic Lake,
W89-00526 2H

Population Dynamics of a Tropical Intertidal and Deep-Water Population of Sargassum polyceratium (Phaeophyceae),
W89-00528 2L

Demographic Study of Aerial Shoots of Carex rostrata in Relation to Water Level,
W89-00530 2H

Annual Cycle of Free-Floating Bacteria in the Bot River Estuary,
W89-00658 2L

Zooplankton and Some Environmental Conditions in the Bot River Estuary,
W89-00659 2L

Changes in the Fish Fauna of the Bot River Estuary in Relation to Opening and Closure of the Estuary Mouth,
W89-00665 2L

Synopsis of the Impact of Artificially Opening the Mouth of the Bot River Estuary: Implications for Management,
W89-00666 2L

Dynamics of Hydra Populations in Lake Zurich, Switzerland, and Lake Maggiore, Italy,
W89-00692 2H

Seasonal Changes of the Profundal Macrobenthic Community in a Polluted Lake,
W89-00693 5C

Exploited Fish and Shellfish Species in the Moray Firth,
W89-00779 2L

Intertidal Macrofauna of Nigg Bay,
W89-00780 2L

Sub-Littoral Fauna of the Inverness, Cromarty and Dornoch Firths,
W89-00784 2L

Status of Fish Populations in the Clyde Estuary,
W89-00809 2L

Recent Changes in Numbers of Waders on the Clyde Estuary, and Their Significance for Conservation,
W89-00810 5C

Patterns of Association Between Birds and Invertebrates in the Clyde Estuary,
W89-00811 2L

Biology of Harpacticoid Copepods in the Meiofauna of Shallow Subtidal Sands,
W89-00818 2L

Benthic Fauna of Sandy Bays, with Particular Reference to Irvine Bay,
W89-00819 5C

Population Dynamics of Seabirds in the Firth of Clyde,
W89-00822 2L

Recent Changes in the Status of Some Clyde Vertebrates,
W89-00826 5C

Distribution of Plaice Eggs and Larvae in the Clyde Sea Area,
W89-00829 2L

Fish, Fleas and Phytoplankton,
W89-00851 5C

Seasonal Phytoplankton Demographic Processes and Experiments on Interspecific Competition,
W89-00906 2H

Phytoplankton and Reversed Eutrophication in Lake Malaren, Central Sweden, 1965-1983,
W89-01188 5G

State of the Ichthyofauna in Istrinsk Reservoir Since Its Conversion into a Recreational Water,
W89-01191 2H

Size Structure of Planktonic Crustaceans in a Dimictic Lake on the Canadian Shield (Structure en Taille des Crustaces Planctoniques d'un Lac Dimictique du Bouclier Canadien),
W89-01231 2H

PORE WATER

Provisional Diagenetic Model for pH in Anoxic Porewaters: Application to the FOAM Site,
W89-00767 2J

POROUS MEDIA

Dispersion in Heterogeneous Porous Media: 1. Local Volume Averaging and Large-Scale Averaging,
W89-00699 5B

Dispersion in Heterogeneous Porous Media: 2. Predictions for Stratified and Two-Dimensional Spatially Periodic Systems,
W89-00700 5B

Water Flow in Layered Soils with Sloping Surface,
W89-00752 2G

Contaminant Transport in Fractured Porous Media: Steady State Solutions by a Boundary Integral Method,
W89-00982 5B

Numerical Transport Model for Oxygen- and Nitrate-Based Respiration Linked to Substrate and Nutrient Availability in Porous Media,
W89-01251 5D

PORTLAND CEMENTS

Effects of Three Organics on Selected Physical Properties of Type I Portland Cement,
W89-00994 5E

Transmission Electron Microscopic Study of Solidified/Stabilized Organics,
W89-01000 5E

POST-FRONTAL PRECIPITATION

54 Hours of Continuous Post-Frontal Precipitation North of the Alpine Mountain Barrier, 22-25 August 1975,
W89-00464 2B

POTABLE WATER

Epidemiological Study of the Legionella pneumophila Presence in Potable Water in Alicante,
W89-00925 5A

POTASH

Modelling of Flow Through Potash Tailings Piles,
W89-00388 5B

POTASSIUM

Nitrogen, Phosphorus and Potassium in Salvinia molesta Mitchell in the Field: Effects of Weather, Insect Damage, Fertilizers and Age,
W89-00113 2H

Nutrient Dynamics in Minerotrophic Peat Mires,
W89-00119 2H

POTENTIOMETRIC STRIPPING ANALYSIS

Indirect Trace Determination of Ethylenediaminetetraacetic Acid (EDTA) in Water by Potentiometric Stripping Analysis,
W89-00481 5A

POTOMAC RIVER

Effects of Increasing Salinity on a Cyanobacteria Bloom in the Potomac River Estuary,
W89-00231 2H

POWERPLANTS

Application of Ecological Modelling: Impact of Thermal Effluent on a Smallmouth Bass Population,
W89-00317 5C

Cogeneration Power Desalination Plants,
W89-01064 3A

Increase of the Reliability and Convenience of Operation of the Group Active Power Regulation System of a Hydroelectric Station,
W89-01179 8C

POYANG LAKE

Hydrological Features of Poyang Lake, (in Chinese),
W89-00532 2H

Probing into the Computation Method on Sedimentary Amount of Poyang Lake, (in Chinese),
W89-00540 2H

POYANG LAKE *LAKES

Hydrological Features of Poyang Lake (II), (in Chinese),
W89-00535 2H

PRAIRIES

Relations Between Habitat Variables and Channel Catfish Populations in Prairie Streams,
W89-00325 2H

PRECIPITATION

Winter Diurnal Trends of Sierra Nevada Supercooled Liquid Water and Precipitation,
W89-00089 3B

Effects of Acidification and Phosphorus Addition on Phytoplankton Biomass and Productivity in a Circum-Neutral Mesotrophic Lake Receiving Acid Precipitation,
W89-00179 2H

Local Influences on the Composition of Precipitation on Bermuda,
W89-00405 2A

Evolution and Fine Structure of a Long-Lived Meso-alpha-Scale Convective System in a Baiu Frontal Zone. Part II: Meso-gamma-Scale Characteristics of Precipitation,
W89-00416 2B

Life Cycle Effects of Cloud Clusters on the Moisture Distribution over the Eastern Atlantic,
W89-00417 2B

Characteristic Features of Supercooled Raindrops in the Mid-Winter Season of Arctic Canada,
W89-00418 2B

54 Hours of Continuous Post-Frontal Precipitation North of the Alpine Mountain Barrier, 22-25 August 1975,
W89-00464 2B

Principal Component Analysis of Precipitation in the Adriatic-Pannonian Area of Yugoslavia,
W89-00472 2B

Regionalization of Daily Rainfall in Kenya by Means of Common Factor Analysis,
W89-00473 2B

El Nino and Its Effect on Precipitation in Arizona and Western New Mexico,
W89-00474 2B

Charge Induced on a Conducting Cylinder by a Point Charge and Its Application to the Measurement of Charge on Precipitation,
W89-00762 7B

Experimental Marvin Windshield Effects on Precipitation Records in Leadville, Colorado,
W89-00876 7B

Spatial Variability of Short-Term Rainfall Amounts in a Coastal Mountain Region of Southern Africa,
W89-00932 2B

Fog Drip as a Source of Groundwater Recharge in Northern Kenya,
W89-00984 2F

Spatial and Temporal Scales in Rainfall Analysis Some Aspects and Future Perspectives,
W89-01021 2B

Hillslope Runoff Processes and Models,
W89-01022 2A

Influence of Altitude on Rainfall Composition at Great Dun Fell,
W89-01146 5B

Influence of Altitude on Wet Deposition: Comparison between Field Measurements at Great Dun Fell and the Predictions of a Seeder-Feeder Model,
W89-01147 5B

Occurrence and Distribution of Trace Organic Compounds in Bermuda Precipitation,
W89-01148 5B

Dissolution of Trace Metals from Particles of Industrial Origin and Its Influence on the Composition of Rainwater,
W89-01149 5B

Acidic Deposition Distribution and Episode Statistics from the MAP3S Network Database,
W89-01151 5B

Wet-Only Precipitation Study in a Mediterranean Site, Patras, Greece,
W89-01152 2B

Determining Microwave Brightness Temperatures from Precipitating Horizontally Finite and Vertically Structured Clouds,
W89-01263 7B

PRECIPITATION DATA

Rain Measurement by Raingage-Radar Combination: A Geostatistical Approach,
W89-00761 7B

PRECIPITATION SCAVENGING

Rain-Aerosol Coupling in Urban Area: Scavenging Ratio Measurement and Identification of Some Transfer Processes,
W89-00430 2B

Effects of Sulphur Deposition on Lake-Water Chemistry in Ontario, Canada,
W89-00846 5B

PREDACTION
Body Size and Mass Flow in Freshwater Plankton: Models and Tests,
W89-00218 2H

PREDICTIONS
Repercussions of a CO2 Doubling on the Water Cycle and on the Water Balance - A Case Study for Belgium,
W89-00355 2A

PRESSURE FLUCTUATIONS
Extreme Pressures in Hydraulic-Jump Stilling Basins,
W89-00896 8B

PRESSUREMETER
Creep of Ice Measured with the Pressuremeter,
W89-00387 2C

PRICING
Funding Reserve Capacity in Wastewater Systems,
W89-00506 5D

PRIMARY PRODUCTION
Increased Phytoplankton Primary Production in the Marsdiep Area (Western Dutch Wadden Sea),
W89-00674 5C

PRIMARY PRODUCTIVITY
Effects of River Discharge and Vertical Circulation on Aquatic Primary Production in a Turbid Louisiana (USA) Estuary,
W89-00005 2L

Biomass Production and Nutrient Cycling in Aquatic Macrophyte Communities of the Chowan River, North Carolina,
W89-00097 2H

Effects of Sediment Properties on Benthic Primary Production in the Columbia River Estuary,
W89-00115 2L

Seasonal Composition, Biomass and Primary Productivity of the Phytoplankton in Lakitelek Backwater during 1980 and 1983,
W89-00144 2H

Modelling Research on the Production Cycle of Phytoplankton in the Southern Bight of the North Sea in Relation to Riverborne Nutrient Loads,
W89-00157 2L

Effect of the Hydrological Regime on Primary Production in the Main Stream and the Side Arms of the River Danube,
W89-00162 2H

Attempt to Estimate the Fish Stock and the Sustainable Yield of Lake Ziway and Lake Abaya, Ethiopian Rift Valley,
W89-00178 2H

Effects of Acidification and Phosphorus Addition on Phytoplankton Biomass and Productivity in a Circum-Neutral Mesotrophic Lake Receiving Acid Precipitation,
W89-00179 2H

Factors Affecting Nutrient Dynamics in a Piedmont North Carolina Reservoir,
W89-00187 2H

Measurement of Primary Productivity in a High-Rate Oxidation Pond (HROP),
W89-00213 2H

Recurrence of Daphnia rosea in Lake Tahoe: Analysis of a Population Pulse,
W89-00216 2H

Zooplankton Community Grazing in a Hypertrophic Lake (Hartbeespoort Dam, South Africa),
W89-00220 2H

Bacterial Response to Seasonal Changes in Primary Production and Phytoplankton Biomass in Lake Constance,
W89-00225 2H

Clouds, Deep Chlorophyll Maxima and the Nutrient Supply to the Mixed Layer of Stratified Water Bodies,
W89-00227 2L

Nitrate and Ammonium Uptake by Plankton in an Amazon River Floodplain Lake,
W89-00229 2H

Regeneration and Uptake of Ammonium by Plankton in an Amazon Floodplain Lake,
W89-00230 2H

Primary Production in Lakes with Cage Trout Culture,
W89-00238 2H

Fish Production in the Kanawha River and its Relation To Barge Traffic,
W89-00249 6G

Typha Productivity in a Texas Pond: Implications for Energy and Nutrient Dynamics in Freshwater Wetlands,
W89-00524 2H

Factors Influencing Aboveground Production of Scirpus Marshes in the St. Lawrence Estuary, Quebec, Canada,
W89-00529 2L

Primary Productivity of the Bot River Estuary, South Africa,
W89-00656 2L

Seasonal Studies on the Phytoplankton and Primary Production in the Inner Firth of Clyde,
W89-00812 2L

Primary Production in the Orinoco River,
W89-00907 2H

PRIMARY WASTEWATER TREATMENT
Dynamic Modeling of Primary Sedimentation,
W89-00483 5D

PRINCIPAL COMPONENT ANALYSIS
Principal Component Analysis of Precipitation in the Adriatic-Pannonian Area of Yugoslavia,
W89-00472 2B

Application of Principal Component Analysis to Long-Term Reservoir Management,
W89-00698 6A

PROBABILISTIC PROCESS
Maximally Informative Environmental Control Policies for Natural Resource Systems with Probabilistic Constraints,
W89-00458 6A

PROBABILITY DISTRIBUTION
Location-Invariant Plotting Positions for PWM Estimation of the Parameters of the GEV Distribution,
W89-00351 2E

Application of Probability Weighted Moments in Estimating the Parameters of the Pearson Type Three Distribution,
W89-01198 7C

Determination of Probability Weighted Moments with the Incorporation of Extraordinary Values into Sample Data and Their Application to Estimating Parameters for the Pearson Type Three Distribution,
W89-01199 7C

PROBABILITY WEIGHTED MOMENTS
Location-Invariant Plotting Positions for PWM Estimation of the Parameters of the GEV Distribution,
W89-00351 2E

PROCESSS CONTROL
Monitoring of Liquid Effluents as Preventative Protection of Natural Bodies of Water (Abwasseruberwachung als vorbeugender Gewasserschutz),
W89-01184 5G

PRODUCTIVITY
Biomass, Productivity and Life History Traits of Juncus militaris Bigel. in Two Rhode Island (U.S.A.) Freshwater Wetlands,
W89-00100 2H

Estimation of Phytoplankton Biomass and Production, and Organic Matter Decomposition in Three Small Field-Ponds,
W89-00252 2H

Water Column Productivity Attributable to Displaced Benthic Diatoms in Well-Mixed Shallow Estuaries,
W89-00297 2L

Effects of Polyculture and Manure Fertilization on Water Quality and Heterotrophic Productivity in Macrobrachium rosenbergii Ponds,
W89-00327 8I

Productivity and Nutrient Cycling of Alaskan Tundra: Enhancement by Flowing Soil Water,
W89-00908 2G

Bacterial Production in Fresh and Saltwater Ecosystems: A Cross-System Overview,
W89-01034 2H

K-Systems Analysis for Determining the Factors Influencing Benthic Microfloral Productivity in a Louisiana Estuary, USA,
W89-01035 2L

Changes in the Ecosystem of the Azov Sea in Relation to Economic Development in the Basin,
W89-01192 6G

PROJECT PLANNING
Petaling Jaya Non-Revenue Water Control Project Selangor, Malaysia,
W89-00923 5F

Planning and Construction of the Pahalgam Scheme,
W89-01004 8A

PROPIONATE
Effect of Sulphide on the Anaerobic Degradation of Propionate,
W89-00625 5D

PROTOZOA
Effect of a Heated Wastewater Discharge upon River Protozoan Species Pool Variability through Time and Space,
W89-00077 5C

Dynamics of Protistan Carbon and Nutrient Cycling,
W89-00383 2L

PSEUDOMONAS
Conjugal Transfer of R68.45 and FP5 between Pseudomonas aeruginosa Strains in a Freshwater Environment,
W89-00728 5B

PUBLIC HEALTH
Guinea Worm Disease in Northern Uganda: A Major Public Health Problem Controllable Through an Effective Water Programme,
W89-00278 5F

PUBLIC HEALTH

Legionnaire's Disease in a Johannesburg Teaching Hospital,
W89-00450 5F

Viability Determination of Ascaris Eggs Recovered from Waste-Water,
W89-00644 5A

Water Supply and Sanitation - Cornerstones of the World Health Organization's Forty Years of International Health Development,
W89-00917 5F

PUBLIC POLICY

New Directions in Nebraska Water Policy,
W89-01266 6E

PUBLIC UTILITY DISTRICTS

Twinning: Utility Pairing,
W89-00424 5F

PUBLIC WATERS

Implications of Public Ownership of Irrigation Canal Systems in the Texas Rice Belt: Impacts on Water Use and Water Price,
W89-00460 6E

PUGET SOUND

Sea-Surface Microlayer of Puget Sound: Part I: Toxic Effects on Fish Eggs and Larvae,
W89-00853 5C

Sea-Surface Microlayer of Puget Sound: Part II: Concentrations of Contaminants and Relation to Toxicity,
W89-00854 5C

PULP AND PAPER INDUSTRY

Environmental Effects of Paper Industry Wastewaters: An Overview,
W89-00362 5C

Organochlorine Compounds in the Environment,
W89-00368 5C

Lignin Residues as Tracers of Organic Waste Transport,
W89-00561 7B

PULP WASTES

Acclimatization of Roach, Rutilus rutilus (L.), to Toxic Components of Kraft Pulp Mill Effluents,
W89-00087 5C

Evaluation of the 'Fugacity' (FEQUM) and the 'EXAMS' Chemical Fate and Transport Models: A Case Study on the Pollution of the Norrsundet Bay (Sweden),
W89-00357 5B

Distribution of Chlorinated Organic Substances from Pulp Mills,
W89-00359 5B

High Molar Mass Lignin in Bleached Kraft Pulp Mill Effluents,
W89-00361 5A

Environmental Effects of Paper Industry Wastewaters: An Overview,
W89-00362 5C

Sublethal Effects of Chlorinated Phenols and Resin Acids on Rainbow Trout (Salmo gairdneri),
W89-00364 5C

Effects of Pulp Mill Effluents on Skeletal Parameters in Fish: A Progress Report,
W89-00365 5C

Effects of Pulp Mill Effluent on a Baltic Coastal Fish Community,
W89-00366 5C

Effects of a Bleached Pulp Mill Effluent on Growth and Gonad Function in Baltic Coastal Fish,
W89-00367 5C

Mutagenicity in Pulp and Paper Mill Effluents and in Recipient,
W89-00370 5C

Biosorption of Organic Halide in a Kraft Mill Generated Lagoon,
W89-01138 5D

PUMPED STORAGE

New Pumped-Storage Station Designs,
W89-00556 8C

Ultrasonic Flowmeter for Testing Units of Large Hydroelectric and Pumped-Storage Stations,
W89-01181 8C

PUMPING

STASOFT: A User-Friendly Interactive Computer Program for Softening and Stabilisation of Municipal Waters,
W89-00935 5F

Analytical Solution for Aquifer Decontamination by Pumping,
W89-00977 5G

PUMPING PLANTS

Hydropower Equipment of the Moscow Canal,
W89-00054 8C

Hydraulic Tests for Reconstructing the Pumping Stations on the Moscow Canal,
W89-00055 8C

Optimization of the Production and Pumping Costs of the Nice Water Network (Optimisation de la Production et des Pompages sur le Reseau d'Eau de Nice),
W89-00922 5F

PUMPING TESTS

Drawdown Interval Analysis: A Method of Determining the Parameters of Shallow Conduit Flow Carbonate Aquifers from Pumping Tests,
W89-00986 2F

Pumping Tests in Nonuniform Aquifers: The Radially Symmetric Case,
W89-01196 2F

PUMPS

Optimization of the Mud Intakes of Dredges with Submersible Pumps,
W89-00044 8C

Transient Liver Pathology in Patients Consuming Water from a Private Well Contaminated by PCBs from a Submersible Water Pump,
W89-00558 5C

PYRENE

Formation of 1-Nitropyrene by Photolysis of Pyrene in Water Containing Nitrite Ion,
W89-00586 5B

PYRUVIC ACIDS

Impact of Manganese Intoxication on the Blood Pyruvic Acid of a Freshwater Tropical Perch Colisa fasciatus,
W89-00263 5A

QIANTAGN RIVER

Concentrations of Trace Metals in the Qiantagnjiang River and its Estuary in Southern China,
W89-00443 5B

QUALITY CONTROL

Reliability of Chemical Analyses of Water Samples: The Experience of the UMTRA Project,
W89-00941 5A

Quality Control Approach to NPDES Compliance Determination,
W89-01136 5D

QUANTUM YIELD

Quantum Yield as a Fundamental Parameter Controlling Vertical Photosynthetic Profiles of Phytoplankton in Lake Constance,
W89-00176 2H

QUEBEC

Organochlorines and Eggshell Thinning in Northern Gannets (Sula bassanus) from Eastern Canada, 1968-1984,
W89-01054 5C

RADAR

Rain Measurement by Raingage-Radar Combination: A Geostatistical Approach,
W89-00761 7B

Identification of Rainfall Type From Weather Radar Data,
W89-00842 2B

Comparison of High-Altitude Remote Aircraft Measurements with the Radar Structure of an Oklahoma Thunderstorm: Implications for Precipitation Estimation from Space,
W89-00844 7B

RADIATION

Comparison of Model-Generated and Satellite-derived Cloud Cover and Radiation Budget,
W89-01262 2A

RADIOACTIVE TRACERS

Investigation of Transport-Processes along the Elbe River Using Chernobyl Radionuclides as Tracers,
W89-00636 5B

Estimating Bacterial Production in Marine Waters from the Simultaneous Incorporation of Thymidine and Leucine,
W89-00729 7B

RADIOACTIVE WASTE DISPOSAL

Groundwater Velocity Magnitude in Radionuclide Transport Calculations,
W89-00903 5B

RADIOACTIVE WASTES

Reactor Accident at Chernobyl: A Possibility to Test Colloid-Controlled Transport of Radionuclides in a Shallow Aquifer,
W89-00990 5B

Possibility of Using Radioactively Polluted Waterbodies for Fish Culture,
W89-01193 3C

RADIOACTIVITY

Radioactivity of the Czechoslovakian Reach of the Danube River (Die Radioaktivitat im tschechoslowakischen Donauabschnitt),
W89-00171 5B

Determination of Gross-Beta Radioactivity in Water of the Changjiang River and Sea Water Near Its Entrance to Sea, (in Chinese),
W89-00534 2H

RADIOACTIVITY EFFECTS

Possibility of Using Radioactively Polluted Waterbodies for Fish Culture,
W89-01193 3C

RADIOACTIVITY TECHNIQUES

Improved Methodology for a Collinear Dual-Energy Gamma Radiation System,
W89-00985 7B

Stable Isotope Study of Recharge Processes in the English Chalk,
W89-01197 2F

RADIOCHEMICAL ANALYSIS
Reactor Accident at Chernobyl: A Possibility to Test Colloid-Controlled Transport of Radionuclides in a Shallow Aquifer,
W89-00990 5B

Determination of Microbial Kinetic Coefficients through Measurement of Initial Rates by Radiochemical Techniques,
W89-01218 5D

RADIOISOTOPES
Radioactivity of the Czechoslovakian Reach of the Danube River (Die Radioaktivitat im tschechoslowakischen Donauabschnitt),
W89-00171 5B

Radionuclides in Drinking Water,
W89-01104 5B

Disposal of Radium Removed from Drinking Water,
W89-01106 5E

Operating a Small Full-Scale Ion Exchange System for Uranium Removal,
W89-01107 5F

RADIOMETRY
Comparison of High-Altitude Remote Aircraft Measurements with the Radar Structure of an Oklahoma Thunderstorm: Implications for Precipitation Estimation from Space,
W89-00844 7B

Differences in the Spectral Characteristics of Birch Canopies Exposed to Simulated Acid Rain,
W89-00849 5C

RADIUM
Disposal of Radium Removed from Drinking Water,
W89-01106 5E

Evaluating Various Adsorbents and Membranes for Removing Radium from Groundwater,
W89-01109 5F

RADIUM RADIOISOTOPES
Occurrence of Radon, Radium, and Uranium in Groundwater,
W89-01108 5B

RADIUM RADIOSOTOPES
Influence of the Vistula River on Distribution of 226Ra in the Gdansk Bay,
W89-00250 2K

RADON
Occurrence of Radon in Well Supplies,
W89-01105 5B

RADON RADIOISOTOPES
Occurrence of Radon, Radium, and Uranium in Groundwater,
W89-01108 5B

RAIN
Aliphatic and Polycyclic Aromatic Hydrocarbons in Urban Rain, Snow and Fog,
W89-00309 5B

Characteristic Features of Supercooled Raindrops in the Mid-Winter Season of Arctic Canada,
W89-00418 2B

RAIN GAGES
Rain Measurement by Raingage-Radar Combination: A Geostatistical Approach,
W89-00761 7B

Experimental Marvin Windshield Effects on Precipitation Records in Leadville, Colorado,
W89-00876 7B

RAIN SAMPLING
Local Influences on the Composition of Precipitation on Bermuda,
W89-00405 2A

RAINFALL
Modified ATI Technique for Nowcasting Convective Rain Volumes over Areas,
W89-00090 2B

El Nino-Southern Oscillation and Rainfall Variability,
W89-00276 2B

Multidimensional Modeling of Cumulative Rainfall: Parameter Estimation and Model Adequacy through a Continuum of Scales,
W89-00706 2B

Evaluation of a Homogeneous Point Process Description of Arizona Thunderstorm Rainfall,
W89-00724 2B

Rain Measurement by Raingage-Radar Combination: A Geostatistical Approach,
W89-00761 7B

Fresh Water Inflows to the Firth of Clyde,
W89-00801 2L

Identification of Rainfall Type From Weather Radar Data,
W89-00842 2B

Comparison of High-Altitude Remote Aircraft Measurements with the Radar Structure of an Oklahoma Thunderstorm: Implications for Precipitation Estimation from Space,
W89-00844 7B

Southwest Branch of the North American Monsoon During Summer 1979,
W89-00845 2A

Spatial Variability of Short-Term Rainfall Amounts in a Coastal Mountain Region of Southern Africa,
W89-00932 2B

Spatial and Temporal Scales in Rainfall Analysis Some Aspects and Future Perspectives,
W89-01021 2B

Influence of Altitude on Rainfall Composition at Great Dun Fell,
W89-01146 5B

Impact of Rainfall and Soil Hydraulic Property Information on Runoff Predictions at the Hillslope Scale,
W89-01246 2E

Temporal Variability in Spatial Correlation of Daily Rainfall,
W89-01247 2B

Determining Microwave Brightness Temperatures from Precipitating Horizontally Finite and Vertically Structured Clouds,
W89-01263 7B

RAINFALL AREA
Modified ATI Technique for Nowcasting Convective Rain Volumes over Areas,
W89-00090 2B

RAINFALL DISTRIBUTION
Life Cycle Effects of Cloud Clusters on the Moisture Distribution over the Eastern Atlantic,
W89-00417 2B

Regionalization of Daily Rainfall in Kenya by Means of Common Factor Analysis,
W89-00473 2B

El Nino and Its Effect on Precipitation in Arizona and Western New Mexico,
W89-00474 2B

Acidic Deposition Distribution and Episode Statistics from the MAP3S Network Database,
W89-01151 5B

Temporal Variability in Spatial Correlation of Daily Rainfall,
W89-01247 2B

RAINFALL INDEX
Landscape and Rainfall Indices for Prediction of Streamflow Similarities in the Hunter Valley, Australia,
W89-00972 2E

RAINFALL PENETRATION
Rain Measurement by Raingage-Radar Combination: A Geostatistical Approach,
W89-00761 7B

RAINFALL RATE
Determining Microwave Brightness Temperatures from Precipitating Horizontally Finite and Vertically Structured Clouds,
W89-01263 7B

RAINFALL-RUNOFF MODELS
Operational Models for Flood Calculations,
W89-01030 2A

RAINFALL-RUNOFF RELATIONHIPS
Estimation of the Time Scale of the Geomorphologic Instantaneous Unit Hydrograph from Effective Streamflow Velocity,
W89-00704 2E

RAINFALL-RUNOFF RELATIONSHIPS
Solute Sources and Transport in an Ephemeral Badland Catchment, Southeastern Alberta, Canada,
W89-00046 2J

Urban Runoff Simulation Model,
W89-00301 2E

Regression Estimates for Topological-Hydrograph Input,
W89-00304 2E

Runoff Generation in a Plough-drained Peat Bog in Southern Scotland,
W89-00345 4C

Storm Response of the Karstic Carbonate Aquifer of Southcentral Kentucky,
W89-00349 2A

Variations of Runoff in the High Plains Section of the Smoky Hill Drainage, 1951-1980,
W89-00394 2A

Chemical-Hydrologic Interactions in the Near-Stream Zone,
W89-00717 2E

Maximum Likelihood Criterion for Use With Data Collected at Unequal Time Intervals,
W89-00723 2E

Evaluating Peat-Mining Hydrology Using DRAINMOD,
W89-00755 4C

Estimation of Catchment Rainfall Uncertainty and its Influence on Runoff Prediction,
W89-00892 2A

Quantity of Stormwater Runoff from Ten Stretches of Road, a Car Park and Eight Roofs in Hertfordshire, England During 1983,
W89-00912 4C

Landscape and Rainfall Indices for Prediction of Streamflow Similarities in the Hunter Valley, Australia,
W89-00972 2E

RAINFALL-RUNOFF RELATIONSHIPS

Methods and Merits of Regional Flood Frequency Analysis,
W89-01020 2E

Hillslope Runoff Processes and Models,
W89-01022 2A

Rainfall-Runoff Modeling: Past, Present and Future,
W89-01023 2A

Hydrological Heterogeneity Catchment Morphology and Catchment Response,
W89-01024 2A

Operational Models for Flood Calculations,
W89-01030 2A

Problems of Rainfall-Runoff Modelling in Arid and Semiarid Regions,
W89-01144 2E

MODALP: A Deterministic Rainfall-Runoff Model for Large Karstic Areas,
W89-01145 2F

Runoff Generation in a Low Arctic Drainage Basin,
W89-01207 2A

Identification of a Multiple Input, Single Output, Linear, Time Invariant Model for Hydrological Forecasting,
W89-01209 7C

Impact of Rainfall and Soil Hydraulic Property Information on Runoff Predictions at the Hillslope Scale,
W89-01246 2E

RARE EARTH ELEMENTS

Surface Reactions of Synthetic, End-member Analogues of Monazite, Xenotime and Rhabdophane, and Evolution of Natural Waters,
W89-01080 2K

RECOVERY

Status of Fish Populations in the Clyde Estuary,
W89-00809 2L

RECREATION

Lake Dredging Boosts Recreational and Esthetic Environments,
W89-00468 5G

Identifying Critical Issues in Recreation Planning and Management: Improving the Management-Research Partnership,
W89-00873 6A

Recreation Resource Allocation Model for Public Drinking Reservoirs,
W89-00921 6D

RECREATION DEMAND

Identifying Critical Issues in Recreation Planning and Management: Improving the Management-Research Partnership,
W89-00873 6A

REEFS

Sensitivity of Coral Reefs to Environmental Pollution,
W89-00440 5C

REFLECTANCE

Particulate Concentrations in Lake St. Clair as Recorded by a Shipborne Multispectral Optical Monitoring System,
W89-00066 7B

REFORESTATION

Effect of Logging and Regeneration on Groundwater, Streamflow and Stream Salinity in the Southern Forest of Western Australia,
W89-00350 4C

REFUGEE CAMPS

Package Water Treatment Facilities for Refugee Communities,
W89-00841 5F

REGENERATION

Sequential Wet Air Regeneration of PAC from the Powdered Carbon-Activated Sludge Process,
W89-01137 5D

REGIONAL ANALYSIS

Methods and Merits of Regional Flood Frequency Analysis,
W89-01020 2E

REGIONAL DEVELOPMENT

Nature Conservation in the Moray Firth,
W89-00776 2L

Coastal Planning in the Moray Firth,
W89-00777 2L

Exploited Fish and Shellfish Species in the Moray Firth,
W89-00779 2L

REGIONAL PLANNING

Networking Urban Water Supplies in West Africa,
W89-00419 5F

Funding Reserve Capacity in Wastewater Systems,
W89-00506 5D

Upgrading Water Systems through Planning,
W89-00746 6B

Planning Indiana's Water Infrastructure from a Competitive Perspective,
W89-00880 6B

Catalyst for Regionalization of Rural Water Systems,
W89-00883 6E

REGRESSION ANALYSIS

Statistical Considerations Associated with the Use of the Heterotrophic Activity Method for Estimating V sub max and K' for Aquatic Environments,
W89-00280 7C

Annual Flow Statistics for Ungaged Streams in Idaho,
W89-00753 7C

Multivariate Periodic ARMA (1,1) Processes,
W89-00967 7B

REGUALTED FLOW

Fish and Fisheries of Regulated Rivers in the UK,
W89-00960 8I

REGULATED FLOW

Use of Map Analysis to Elucidate Flooding in an Australian Riparian River Red Gum Forest,
W89-00722 2E

Regulated Rivers in the United Kingdom,
W89-00948 4A

Regulating the River Severn,
W89-00954 4A

Regulation of the River Thames: A Case Study on the Teddington Flow Proposal,
W89-00955 4A

River Regulation by Seasonal Groundwater Abstraction: The Case of the River Itchen,
W89-00956 4B

Hydrological Changes and the River Regulation in the UK,
W89-00957 4A

Channel Change and Sediment Transport in Regulated U.K. Rivers,
W89-00958 2J

River Regulation and Nature Conservation,
W89-00961 4A

Streamflow Regulation and Fish Community Structure,
W89-01053 4A

REGULATED RIVERS

Regulated Rivers in the United Kingdom,
W89-00948 4A

River Regulation in the United Kingdom: An Historical Perspective,
W89-00949 4A

River Regulation: A Regional Perspective - Northumbrian Water Authority,
W89-00950 4A

Hydropower Development on Rivers in Scotland,
W89-00952 8C

Regulation of the River Dee,
W89-00953 4A

Regulating the River Severn,
W89-00954 4A

Regulation of the River Thames: A Case Study on the Teddington Flow Proposal,
W89-00955 4A

River Regulation by Seasonal Groundwater Abstraction: The Case of the River Itchen,
W89-00956 4B

Hydrological Changes and the River Regulation in the UK,
W89-00957 4A

Channel Change and Sediment Transport in Regulated U.K. Rivers,
W89-00958 2J

Impact of River Regulations on Invertebrate Communities in the U.K.,
W89-00959 4A

Fish and Fisheries of Regulated Rivers in the UK,
W89-00960 8I

River Regulation and Nature Conservation,
W89-00961 4A

Environmentally Sound River Engineering Examples from the Thames Catchment,
W89-00962 4A

Outstanding Problems in River Regulation,
W89-00963 4A

REGULATIONS

Cost Efficiency of Transferable Discharge Permit Markets for Control of Multiple Pollutants,
W89-00697 5G

Prospects for Transfer of the California Coastal Conservancy Model for Habitat Restoration to Other Coastal States,
W89-01070 6E

New Regulations: A Challenge for Small Systems,
W89-01118 5F

Pesticides: A Continuing Dilemma,
W89-01122 5B

RELATIVE HUMIDITY
Comparison of Model-Generated and Satellite-derived Cloud Cover and Radiation Budget,
W89-01262 2A

RELIABILITY
Increase of the Reliability and Convenience of Operation of the Group Active Power Regulation System of a Hydroelectric Station,
W89-01179 8C

REMEDIES
Design Criteria for In-Situ and On-Site Renovation of an Industrial Sludge Lagoon,
W89-00996 5B

REMOTE SENSING
Power Facilities of the Moscow Canal,
W89-00053 8C

Determinations of Suspended Sediment Concentrations from Multiple Day Landsat and AVHRR Data,
W89-00064 7B

Landsat-MSS Radiance as a Measure of Suspended Sediment in the Lower Yellow River (Hwang Ho),
W89-00065 7B

Particulate Concentrations in Lake St. Clair as Recorded by a Shipborne Multispectral Optical Monitoring System,
W89-00066 7B

Estimation of Bare Soil Evaporation from Airborne Measurements,
W89-00352 7B

Remote Sensing Applications in Water Resource Prospecting and Management,
W89-00459 7B

Study of Modern Vicissitudes of the Jianghan Lake Group by Using Remote Sensing Techniques,
W89-00542 2H

Satellite Data and Geographical Information System for Land Use Classification,
W89-00756 7B

Rain Measurement by Raingage-Radar Combination: A Geostatistical Approach,
W89-00761 7B

Satellite Observations of Tidal Upwelling and Mixing in the St. Lawrence Estuary,
W89-00834 2L

Identification of Rainfall Type From Weather Radar Data,
W89-00842 2B

Comparison of High-Altitude Remote Aircraft Measurements with the Radar Structure of an Oklahoma Thunderstorm: Implications for Precipitation Estimation from Space,
W89-00844 7B

Dry Stream Reaches in Carbonate Terranes: Surface Indicators of Ground-Water Reservoirs,
W89-00870 7B

Progress in Developing an Operational Snowmelt-Runoff Forecast Model with Remote Sensing Input,
W89-00891 2A

Macrohydrology: The New Challenge for Process Hydrology,
W89-01012 2A

Remote Sensing in Hydrology,
W89-01019 2A

Determining Microwave Brightness Temperatures from Precipitating Horizontally Finite and Vertically Structured Clouds,
W89-01263 7B

REPRODUCTION
Recurrence of Daphnia rosea in Lake Tahoe: Analysis of a Population Pulse,
W89-00216 2H

Biology and Management of Herring and Other Pelagic Fish Stocks in the Firth of Clyde,
W89-00825 2L

RESEARCH
Long-Term Ecological Research on Illinois Rivers,
W89-00401 2H

RESEARCH PRIORITIES
Identifying Critical Issues in Recreation Planning and Management: Improving the Management-Research Partnership,
W89-00873 6A

Hydrological Perspective,
W89-01011 2A

RESERVOIR DESIGN
Value of Stochastic Streamflow Models in Overyear Reservoir Design Applications,
W89-01244 2E

RESERVOIR EFFECTS
Hydrological Changes and the River Regulation in the UK,
W89-00957 4A

RESERVOIR OPERATION
Application of Principal Component Analysis to Long-Term Reservoir Management,
W89-00698 6A

Optimization Model for Screening Multipurpose Reservoir Systems,
W89-00703 6A

Regulating the River Severn,
W89-00954 4A

Gradient Dynamic Programming for Stochastic Optimal Control of Multidimensional Water Resources Systems,
W89-00979 6A

RESERVOIR OPERATIONS
Developing Release Schedules for a Gated Spillway,
W89-01006 8A

RESERVOIR STORAGE
Hydropower Development on Rivers in Scotland,
W89-00952 8C

RESERVOIRS
Seasonal and Short-Term Fluctuations in the Zooplankton Community of Paranoa Reservoir, Brasilia, Federal District, Brazil (Flutuacoes Sazonais e de Curta Duracao na Comunidade Zooplanktonica do Lago Paranoa, Brasilia-DF, Brasil),
W89-00006 2H

Nutrient Release Through Decomposition of Diplodon Delodontus Expansus (Mollusca, Bivalvia) and Some Considerations of its Effects on the Ecology of a Small Tropical Reservoir,
W89-00009 2H

Fish Communities in Reservoirs in Southern Brazil (Comunidades de Peixes de Reservatorios no Sul do Brasil),
W89-00011 2H

Components of Forces of a Reservoir Acting on the Foundation of High Dams,
W89-00073 8B

Impact of Impounding on the Oxygen Balance of the Danube from Kelheim to Jochenstein Microbiological-Biochemical Investigations and Water Quality Model Calculations (Zum Einfluss der Straureglierung auf den Sauerstoffhaushalt der Donaustrecke Kelheim-Jochenstein: Mikrobiologisch-biochemische Untersuchungen und Gutemodellrechnungen),
W89-00173 6G

Factors Affecting Nutrient Dynamics in a Piedmont North Carolina Reservoir,
W89-00187 2H

Short-term Dynamics of a Melosira Population in the Plankton of an Impoundment in Central Chile,
W89-00214 2H

Zooplankton Community Grazing in a Hypertrophic Lake (Hartbeespoort Dam, South Africa),
W89-00220 2H

Eutrophication of Lakes and Reservoirs: A Framework for Making Management Decisions,
W89-00439 5C

Mixing of Temperature-Stratified Lakes and Reservoirs by Buoyant Jets,
W89-00492 5G

Calculation of Channel Deformations of Large Earth Canals with Damless Water Intake from Reservoirs,
W89-00553 8A

Recreation Resource Allocation Model for Public Drinking Reservoirs,
W89-00921 6D

Regulating the River Severn,
W89-00954 4A

Impact of River Regulations on Invertebrate Communities in the U.K.,
W89-00959 4A

Hydrogen Ion Concentration and Alkalinity of Reservoir Water in the Sierra Nevada, California, and Correlations with Air Pollutants,
W89-01165 5B

RESINS
Effective Coatings for Hydraulic Structures,
W89-00075 8G

Sublethal Effects of Chlorinated Phenols and Resin Acids on Rainbow Trout (Salmo gairdneri),
W89-00364 5C

Characterization of the Interaction Between Viruses and a Solid Polymeric Contact Disinfectant,
W89-00884 5F

Review of the Use of XAD Resins to Concentrate Organic Compounds in Water,
W89-01215 5A

RESISTIVITY
General Correction for Spontaneous Potential Well Logs in Fresh Water,
W89-01195 7B

RESOURCES
Stochastic Forecast of Water Losses,
W89-00759 7B

RESOURCES DEVELOPMENT
New Life for Small Hydroelectric Stations in Kirgizia,
W89-00042 8C

Future Prospects for Hydro Electricity and Windpower,
W89-00793 6C

RESOURCES MANAGEMENT
Identifying Critical Issues in Recreation Planning and Management: Improving the Management-Research Partnership,
W89-00873 6A

State Equitable Apportionment of Western Water Resources,
W89-01267 6E

Changing Meaning of Water Conservation in the West,
W89-01269 6E

RESPIRATION
Effect of 3,4 Benzopyrene on the Photosynthetic and Respiratory Intensity of the Green Alga Scenedesmus quadricauda (Der Einfluss von 3,4-Benzpyren aud die Photosynthese- une Respirationsintensitat der Gruenalge Scenedesmus quadricauda),
W89-00135 5C

Benthic Chamber for Use in Rivers: Testing against Oxygen Mass Balances,
W89-00488 7B

RETAINING WALLS
Certain Characteristics of Calculating Angular Retaining Walls,
W89-00076 8A

REVEGETATION
Seed Germination Traits of Annuals and Emergents Recruited during Drawdowns in the Delta Marsh, Manitoba, Canada,
W89-00126 2H

REVERSE OSMOSIS
Formation of Hydrous Zirconium (IV) Oxide Polyelectrolyte Membranes, I. Poly (itaconic acid) and Poly (acrylic-co-itaconic acid),
W89-01062 3A

RO Desalination in Northwest China,
W89-01065 3A

Preliminary Plan for Membrane Desalination in China,
W89-01066 3A

Evaluating Various Adsorbents and Membranes for Removing Radium from Groundwater,
W89-01109 5F

REVETMENTS
Filterless Revetment of the Slopes of Dikes at Pumped-storage Station Reservoirs,
W89-00058 8A

Size of the Concrete Part of a Combined Apron below Low-head Outlet Works,
W89-01175 8B

REVIEWS
Waste Allocation Simulation Models,
W89-01234 5D

RHEOLOGY
Creep of Ice Measured with the Pressuremeter,
W89-00387 2C

Laboratory Analysis of Mudflow Properties,
W89-00899 2J

RHINE
Ecological and Saprobiological Status of the Rhine (Der Oekologisch-Saprobiologische Zustand des Rheins),
W89-00498 2H

RHODE ISLAND
Nitrogen Dynamics in Lower Narragansett Bay: II. Phytoplankton Uptake, Depletion Rates of Nitrogenous Nutrient Pools, and Estimates of Ecosystem Remineralization,
W89-00215 2L

RICE
Implications of Public Ownership of Irrigation Canal Systems in the Texas Rice Belt: Impacts on Water Use and Water Price,
W89-00460 6E

Water Management for Lowland Rice Irrigation,
W89-00750 3F

RIO PARDO RESERVOIR
Nutrient Release Through Decomposition of Diplodon Delodontus Expansus (Mollusca, Bivalvia) and Some Considerations of its Effects on the Ecology of a Small Tropical Reservoir,
W89-00009 2H

RISK ASSESSMENT
Risk Analysis for Fish Diversion Experiments: Pumped Intake Systems,
W89-00318 8I

RISKS
Estimation of the Risk Associated with the Organic Constituents of Hazardous and Municipal Waste Landfill Leachates,
W89-00995 5B

Risk: A Key Water Policy Issue,
W89-01123 6D

RIVER BASINS
International Control of Cross-Media Pollution: An Ecosystem Approach,
W89-00520 5G

Cost Efficiency of Transferable Discharge Permit Markets for Control of Multiple Pollutants,
W89-00697 5G

Estimation of the Time Scale of the Geomorphologic Instantaneous Unit Hydrograph from Effective Streamflow Velocity,
W89-00704 2E

Maximum Likelihood Criterion for Use With Data Collected at Unequal Time Intervals,
W89-00723 2E

Outstanding Problems in River Regulation,
W89-00963 4A

RIVER DEE
Regulation of the River Dee,
W89-00953 4A

RIVER EMS
River Ems: Processes Affecting the Behaviour of Metals and Organochlorines during Estuarine Mixing,
W89-00149 5B

RIVER FLOW
Effects of River Discharge and Vertical Circulation on Aquatic Primary Production in a Turbid Louisiana (USA) Estuary,
W89-00005 2L

Fresh Water Inflows to the Firth of Clyde,
W89-00801 2L

Friction Factor Evaluation in Gravel-Bed Rivers,
W89-00898 8B

Regulating the River Severn,
W89-00954 4A

RIVER REGULATIONS
River Regulation: A Regional Perspective - Northumbrian Water Authority,
W89-00950 4A

Water Quality Management: A Regional Perspective-The Severn-Trent Area,
W89-00951 5G

Regulation of the River Dee,
W89-00953 4A

RIVER SEVERN
Recent Transport of Metals in the River Severn as Recorded by the Sediments of Chelmarsh Reservoir, Shropshire, U.K.,
W89-00885 5B

RIVER SYSTEMS
Fractal Nature of River Networks,
W89-00975 2E

RIVER TEES
River Regulation: A Regional Perspective - Northumbrian Water Authority,
W89-00950 4A

RIVER TYNE
River Regulation: A Regional Perspective - Northumbrian Water Authority,
W89-00950 4A

RIVER ZSCHOPAU
Oxygen Budget of a River in Submerged Macrophytes (River Zschopau in the South of the GDR),
W89-00137 2H

RIVERS
Longitudinal Changes in Fish Assemblages and Water Quality in the Willamette River, Oregon,
W89-00029 2H

Solubilities of Trace Copper and Lead Species and the Complexing Capacity of River Water in the Linggi River Basin,
W89-00084 5B

Biomass and Nutritive Potential of Vallisneria americana Michx in Navigation Pool 9 of the Upper Mississippi River,
W89-00093 2H

Effect of the Hydrological Regime on Primary Production in the Main Stream and the Side Arms of the River Danube,
W89-00162 2H

Interaction of Some Environmental Factors in the Danube Delta on the Delimitation of the Vital Space Occupied by the Reed, Mace Reed and Sedge Cenoses (Die Einwirkung einiger Umweltfaktoren des Donaudeltas auf die Abgrenzung des Lebensraumes von Schilf-, Rohrkolben- und Seggengesellschaften),
W89-00163 2H

Structure of Macrobenthic Biomass in the Gravel Bed of the Pre-Alpine Loisach River (Die Struktur der makrobenthischen Biomasse in einem voralpinen Schotterbett am Beispiel der mittleren Loisach),
W89-00167 2H

Bacterial Degradation of Crude Oil Water Pollutants in Danube Water (Die bakterielle Degradation von Erdolkohlenwasserstoffen im Donauwasser),
W89-00168 5B

Determination of Organic Matter in River Sediments,
W89-00169 7B

Phytoplankton Studies of Slowly Running Waters: Rivers Danube and Vils (Phytoplanktonstudien an langamfliessenden Gewassern: Donau und Vils),
W89-00172 2E

New Aspects of the Sulfur Cycle, with Special Reference to Shallow Waters,
W89-00183 5B

River Improvement Planning for Flood Protection in the Kiso River Basin until the Meiji Era, (in Japanese),
W89-00204 4A

Inhabitants' Life in the Lowland of the Kiso, Nagara and Ibi Rivers, (in Japanese),
W89-00205 4A

Species Diversity of Algal Flora in Vishwamitri River, Baroda (India),
W89-00234 2H

Impacts of Navigation on Riverine Fish Production in the United States,
W89-00248 6G

Fish Production in the Kanawha River and its Relation To Barge Traffic,
W89-00249 6G

River-Forced Estuarine Plumes,
W89-00414 2L

Dynamic Changes and Processes in the Mississippi River Delta,
W89-00469 2J

Influence of Selected Organic Complexing Agents on the Sorption of Heavy Metals in River Sediments (Einfluss Ausgewaehlter Organischer Komplexbildner auf die Sorption von Schwermetallen an Gewaessersedimente),
W89-00501 5B

Determination of Gross-Beta Radioactivity in Water of the Changjiang River and Sea Water Near Its Entrance to Sea, (in Chinese),
W89-00534 2H

Chromium Speciation in the Huanghe River and Its Estuarine Region, (in Chinese),
W89-00544 5B

Calculation of Channel Deformations of Large Earth Canals with Damless Water Intake from Reservoirs,
W89-00553 8A

Ecological Parameter of Surface Water in Northeastern Greece,
W89-00564 5B

Correlation of Some Organic Pollution Factors in Water Systems in Northern Greece,
W89-00566 5B

Comparative Study of Heavy Metals Pollution in Various Rivers and Lakes of Northern Greece,
W89-00571 5B

Polychlorinated Biphenyls in the Kupa River, Croatia, Yugoslavia,
W89-00609 5B

Effects of Current Velocity on the Physical Structuring of Diatom (Bacillariophyceae) Communities,
W89-00686 2E

Contamination of Surface Sediments of the Principal Rivers of Geneva Canton by Polychlorinated Biphenyls and DDT (Contamination des Sediments Superficiels des Principales Rivieres du Canton de Geneve par les Polychlorobiphenyles et DDT),
W89-00690 5B

Use of Map Analysis to Elucidate Flooding in an Australian Riparian River Red Gum Forest,
W89-00722 2E

Survey of the International Law of Rivers,
W89-00835 6E

Recent Transport of Metals in the River Severn as Recorded by the Sediments of Chelmarsh Reservoir, Shropshire, U.K.,
W89-00885 5B

Primary Production in the Orinoco River,
W89-00907 2H

Regulated Rivers in the United Kingdom,
W89-00948 4A

River Regulation in the United Kingdom: An Historical Perspective,
W89-00949 4A

Water Quality Management: A Regional Perspective-The Severn-Trent Area,
W89-00951 5G

Hydrological Changes and the River Regulation in the UK,
W89-00957 4A

Erosion and Sediment Yield Research: Some Recent Perspectives,
W89-01015 2J

Methods and Merits of Regional Flood Frequency Analysis,
W89-01020 2E

Operational Models for Flood Calculations,
W89-01030 2A

Comparison of Three Sediment Bioassay Methods Using Detroit River Sediments,
W89-01097 5A

Factors Affecting the Efficiency of Some Estimates of Fluvial Total Phosphorus Load,
W89-01249 5B

ROACH

Acclimatization of Roach, Rutilus rutilus (L.), to Toxic Components of Kraft Pulp Mill Effluents,
W89-00087 5C

ROCK EXCAVATION

Gas Shows during Construction of Hydraulic Tunnels,
W89-00071 8E

ROCK FILTERS

Review of Rock Filters for the Upgrade of Lagoon Effluents,
W89-01235 5D

ROCK GASES

Gas Shows during Construction of Hydraulic Tunnels,
W89-00071 8E

ROCK MECHANICS

Calculation of Pressure Tunnel Linings with Consideration of Consolidation Grouting of the Rocks,
W89-00547 8C

Determination of the Mechanical Characteristics of Rocks by the Method of Volume Confinement of Deformations,
W89-00548 8E

ROMANIA

Viral Pollution of Surface Waters by Domestic Waste Water Discharge (Die Viral-Verunreinigung der Oberflachengewasser durch Ableiten der Haushaltsabwasser),
W89-00170 5B

ROOT ZONE

Linear Root Water Uptake Model,
W89-00353 2I

ROOTS

Relationship between Nitrogen-Fixing Sulfate Reducers and Fermenters in Salt Marsh Sediments and Roots of Spartina alterniflora,
W89-00732 2L

ROTIFERS

Zooplankton Population of Man-Made Lakes in Abruzzi's Appennines: Campotosto Lake (Popolamento Zooplanctonico di un Lago di Sbarramento Dell'Appennino Abruzzese: Il Lago di Campotosto),
W89-00197 2H

Rotifers of Warri River, Nigeria,
W89-00222 2H

RUNOFF

Effect of Runoff Variability on Deformation of Erodible Channels near Structures,
W89-00072 2J

Variations of Runoff in the High Plains Section of the Smoky Hill Drainage, 1951-1980,
W89-00394 2A

Size Distribution and Copper Association of Dissolved Organic Material in Urban Runoff,
W89-00628 5B

Hillslope Runoff Processes and Models,
W89-01022 2A

Rainfall-Runoff Modeling: Past, Present and Future,
W89-01023 2A

Hydrological Heterogeneity Catchment Morphology and Catchment Response,
W89-01024 2A

RUNOFF COEFFICIENT

Quantity of Stormwater Runoff from Ten Stretches of Road, a Car Park and Eight Roofs in Hertfordshire, England During 1983,
W89-00912 4C

RUNOFF FORECASTING

Progress in Developing an Operational Snowmelt-Runoff Forecast Model with Remote Sensing Input,
W89-00891 2A

Approximate Confidence Intervals for Verification Criteria of the WMO Intercomparison of Snowmelt Runoff Models,
W89-01143 2E

Problems of Rainfall-Runoff Modelling in Arid and Semiarid Regions,
W89-01144 2E

Impact of Rainfall and Soil Hydraulic Property Information on Runoff Predictions at the Hillslope Scale,
W89-01246 2E

RUNOFF PLOTS

Runoff Generation in a Plough-drained Peat Bog in Southern Scotland,
W89-00345 4C

RUNOFF VOLUME

Quantity of Stormwater Runoff from Ten Stretches of Road, a Car Park and Eight Roofs in Hertfordshire, England During 1983,
W89-00912 4C

RURAL AREAS

Catalyst for Regionalization of Rural Water Systems,
W89-00883 6E

Effect of Upgrading a Tubewell Water Supply in Rural Areas of Bangladesh,
W89-00920 5F

Rural Community Assistance Program,
W89-01115 5F

SAANICH INLET
Seasonal Variations and Spatial Gradients of Nitrogenous Nutrients in Waters of Southeastern Vancouver Island, British Columbia, Canada.
W89-00158 2L

SAFE DRINKING WATER ACT
SDWA Amendments: Small Community Compliance,
W89-01112 6E

Financing Strategies for Small Systems,
W89-01113 5F

New Regulations: A Challenge for Small Systems,
W89-01118 5F

SAFETY
Prospects of Improving the Prediction of the Hazard of Rock Bursts During Tunneling,
W89-00038 8E

How Safe is Your Water Plant,
W89-00462 5F

SAGUENAY FJORD
Physicochemical and Geotechnical Characteristics of Recent Saguenay Fjord Sediments,
W89-00390 2J

SAINT LAWRENCE RIVER
Dissolved Mercury Behaviour in the Saint Lawrence Estuary,
W89-00285 5B

SALINE-FRESHWATER INTERFACES
Concerning Certain Studies on Seepage and Dissolution of Salts in the Foundation of Dams,
W89-00062 10C

Hydrology of the Bot River Estuary,
W89-00654 2L

Clyde Sea Hydrography,
W89-00802 2L

Dynamics of Saltwater Intrusion in Coastal Channels,
W89-00833 2L

SALINE LAKE
Spatial and Temporal Distribution Patterns of Three Trophic Levels in a Saline Lake,
W89-00219 2H

SALINE LAKES
Distribution, Dynamics and Productivity of a Colonizing (Polydora quadrilobata) and an Established (P. ligni) Polydorid Polychaete in Lake Grevelingen: An Enclosed Estuary in the SW Netherlands,
W89-00002 2H

SALINE SOILS
Hydrogeology of Two Saskatchewan Tills. II. Occurrence of Sulfate and Implications for Soil Salinity,
W89-01202 2F

SALINE WATER
Microscale Haline Convection - A Proposed Mechanism for Transport and Mixing at the Water Table Region,
W89-00718 2F

SALINE WATER INTRUSION
Experimental Determination of Salt Intrusion Mechanisms in the Volkerak Estuary,
W89-00667 2L

Studies on Formations and Changes of Micro-Stratification in Blackish Water Lake Shinji, (in Japanese),
W89-00772 2H

Dynamics of Saltwater Intrusion in Coastal Channels,
W89-00833 2L

SALINITY
Correlations between Salinity and Growth of the Seagrass Amphibolis antarctica (Labill.) Sonder & Aschers., in Shark Bay, Western Australia, Using a New Method for Measuring Production Rate,
W89-00102 2L

Outwelling from Tropical Tidal Salt Flats,
W89-00140 2L

Faunas of Land-Locked Lagoons: Chance Differences and the Problems of Dispersal,
W89-00141 2L

Nitrite and Ammonia in the Tamar Estuary,
W89-00154 5B

Nutrient Levels and the Development of Diatom and Blue-Green Blooms in a Shallow Australian Estuary,
W89-00211 2H

Effects of Increasing Salinity on a Cyanobacteria Bloom in the Potomac River Estuary,
W89-00231 2H

Effect of Logging and Regeneration on Groundwater, Streamflow and Stream Salinity in the Southern Forest of Western Australia,
W89-00350 4C

Zooplankton and Some Environmental Conditions in the Bot River Estuary,
W89-00659 2L

Mass Mortality of Fish Associated with Low Salinity Conditions in the Bot River Estuary,
W89-00664 2L

Dynamical Structure of Vertically Two-Dimensional Estuary in Steady State,
W89-00680 2L

Trace Metal Geochemistry of Pore Water Brines from Two Hypersaline Lakes,
W89-01079 2K

Sediments in the Estuarine Environment of the Tigris/Euphrates Delta; Iraq; Arabian Gulf,
W89-01083 2L

SALMON
Physiological Effects on Coho Salmon and Steelhead of Exposure to Suspended Solids,
W89-00292 5C

Effects of Stream Cleaning on Juvenile Coho Salmon and Dolly Varden in Southeast Alaska,
W89-00374 2H

Homing of Adult Chinook Salmon after Brief Exposure to Whole and Dispersed Crude Oil,
W89-00375 5C

Migratory Salmonids of the Estuary and Firth of Clyde,
W89-00828 5G

SALT
State Program Solves County Salt Storage Problem,
W89-00466 5G

SALT BALANCE
Concerning Certain Studies on Seepage and Dissolution of Salts in the Foundation of Dams,
W89-00062 10C

SALT FLATS
Outwelling from Tropical Tidal Salt Flats,
W89-00140 2L

SALT MARSHES
Contribution of Spartina alterniflora to the Pedra de Guaratiba (RJ) Salt Marsh Sediment Using Carbon-13 as a Tracer (Contribuicao de Materia Organica de Spartina alterniflora Para o Sedimento do Alagado de Pedra de Guaratiba (RJ): Uso de C13 como Tracador),
W89-00010 2L

Spartina alterniflora Die-Back in Louisiana: Time-Course Investigation of Soil Waterlogging Effects,
W89-00286 2H

Populations of Anaerobic Phototrophic Bacteria in a Spartina alterniflora Salt Marsh,
W89-00333 2L

Flux of Organic Carbon in a Tidal Salt Marsh, Kowie River Estuary, Port Alfred, South Africa,
W89-00453 2L

Decomposition of Roots of Three Plant Communities in a Dutch Salt Marsh,
W89-00527 2L

Relationship between Nitrogen-Fixing Sulfate Reducers and Fermenters in Salt Marsh Sediments and Roots of Spartina alterniflora,
W89-00732 2L

Saltmarshes of the Firth of Clyde,
W89-00830 2L

Peat Accumulation and the Success of Marsh Plants,
W89-00909 2H

Patterns of Sulfate Reduction and the Sulfur Cycle in a South Carolina Salt Marsh,
W89-01046 2K

SALT TOLERANCE
Effect of Salinity and Temperature Variations on the Bacterial Population in the Bot River Estuary,
W89-00657 2L

SALTS
Hydrogeology of Two Saskatchewan Tills. II. Occurrence of Sulfate and Implications for Soil Salinity,
W89-01202 2F

SALVINIA
Chemical Environment of Salvinia molesta Mitchell: Ionic Concentrations of Infested Waters,
W89-00106 5B

SAMICA STESZEWSKA RIVER
Effect of Witobelskie and Lodzko-Dymaczewskie Lakes on Phytoplankton of Samica Steszewska River,
W89-00247 2H

SAMPLE PREPARATION
Evaluation of Disposable Membrane Filter Units for Sorptive Losses and Sample Contamination,
W89-00623 5A

Sequential Extraction of Phosphorus and Heavy Metals from Sediments: Methodological Considerations,
W89-00629 5A

SAMPLE PRESERVATION
Oxygen Transfer Through Flexible Tubing and Its Effects on Ground Water Sampling Results,
W89-00943 5A

SAMPLERS
Simple Self-Acting Hydrobiological Sampler (Prosty samoczynny czerpacz hydrobiologiczny),
W89-00033 7B

Discrete Point Sampler for Ground Water Monitoring Wells,
W89-00947 7B

SAMPLING
Simple Self-Acting Hydrobiological Sampler (Prosty samoczynny czerpacz hydrobiologiczny),
W89-00033 7B

Radioactivity of the Czechoslovakian Reach of the Danube River (Die Radioaktivitat im tschechoslowakischen Donauabschnitt),
W89-00171 5B

Rain Acidity in Stellenbosch,
W89-00454 5A

Field Measurements of Water-Air Exchange of Mercury in Freshwater Systems,
W89-00640 5A

Sediment-Water Core Sampler for Coastal Pollution Studies,
W89-00641 5A

There's No Such Thing as a Representative Ground Water Sample,
W89-00937 5A

Oxygen Transfer Through Flexible Tubing and Its Effects on Ground Water Sampling Results,
W89-00943 5A

Sensitivity of Four Monitoring Well Sampling Systems to Low Concentration of Three Volatile Organics,
W89-00944 5A

Screened Auger Sampling: The Technique and Two Case Studies,
W89-00945 5A

Discrete Point Sampler for Ground Water Monitoring Wells,
W89-00947 7B

Simple, Reliable, and Inexpensive Pore-Water Sampler,
W89-01051 7B

Comparing Headspace with Purge and Trap for Analysis of Volatile Priority Pollutants,
W89-01119 5A

Determination of Probability Weighted Moments with the Incorporation of Extraordinary Values into Sample Data and Their Application to Estimating Parameters for the Pearson Type Three Distribution,
W89-01199 7C

Sampling Strategies and Associated Errors in Estimating Epilimnetic Chlorophyll in Eutrophic Lakes,
W89-01242 2H

SAMPLING DEVICES
Chromium Trace Determination in Inorganic, Organic and Aqueous Samples with Isotope Dilution Mass Spectrometry (Chromspurenbestimmungen in Anorganischen, Organischen und wa-Brigen Proben mit der Massenspektrometrischen Isotopenverdunnungsanalyse),
W89-00268 5A

Wound Fiberglass Depth Filters as a Less Expensive Approach for the Concentration of Viruses from Water,
W89-00279 5A

SAN FRANCISCO BAY
Effects of Organic Contaminants on Reproduction of the Starry Flounder Platichthys stellatus in San Francisco Bay. I. Hepatic Contamination and Mixed-Function Oxidase (MFO) Activity During the Reproductive Season,
W89-00385 5C

Pollution Beneath the Golden Gate,
W89-00852 5C

SAND
Dredging Activities in the Dutch Wadden Sea: Effects on Macrobenthic Infauna,
W89-00151 2L

Suspension of Large Concentrations of Sands,
W89-00900 2J

Aragonite-to-Calcite Transformation During Fresh-Water Diagenesis of Carbonates: Insights from Pore-Water Chemistry,
W89-01076 2K

Measurement of Shallow Water Wave Direction for Longshore Sediment Transport,
W89-01082 2J

SAND FILTERS
Package Water Treatment Facilities for Refugee Communities,
W89-00841 5F

Empirical Correlation for Estimating Pressure Drop Across Clogged Filters,
W89-00924 5F

SAND SEAS
Stokes Surfaces and the Effects of Near-Surface Groundwater-Table on Aeolian Deposition,
W89-00410 2J

SANITATION
Fecal Coliform Fingertip Count: A Potential Method for Evaluating the Effectiveness of Low Cost Water Supply and Sanitation Initiatives,
W89-00379 5G

Water Supply and Sanitation - Cornerstones of the World Health Organization's Forty Years of International Health Development,
W89-00917 5F

SASKATCHEWAN
Hydrogeology of Two Saskatchewan Tills. I. Fractures, Bulk Permeability, and Spatial Variability of Downward Flow,
W89-01201 2F

Hydrogeology of Two Saskatchewan Tills. II. Occurrence of Sulfate and Implications for Soil Salinity,
W89-01202 2F

SATELLITE TECHNOLOGY
Determinations of Suspended Sediment Concentrations from Multiple Day Landsat and AVHRR Data,
W89-00064 7B

Landsat-MSS Radiance as a Measure of Suspended Sediment in the Lower Yellow River (Hwang Ho),
W89-00065 7B

Mesoscale Spiral Vortex Embedded within a Lake Michigan Snow Squall Band: High Resolution Satellite Observations and Numerical Model Simulations,
W89-00748 2B

Satellite Data and Geographical Information System for Land Use Classification,
W89-00756 7B

Satellite Observations of Tidal Upwelling and Mixing in the St. Lawrence Estuary,
W89-00834 2L

SATURATED SOILS
Finite Element Computation of Shape Factors for Kirkham's Piezometer Tube Method for Hydraulic Conductivity of Saturated Soil,
W89-00911 2G

SCADA SYSTEMS
Making the Right Moves in SCADA Selection,
W89-01103 5F

SCAPA FLOW
Development of Mass Blooms of Photosynthetic Bacteria on Sheltered Beaches in Scapa Flow, Orkney Islands,
W89-00795 2L

SCENEDESMUS
Effect of 3,4 Benzopyrene on the Photosynthetic and Respiratory Intensity of the Green Alga Scenedesmus quadricauda (Der Einfluss von 3,4-Benzpyren aud die Photosynthese- une Respirationsintensitat der Gruenalge Scenedesmus quadricauda),
W89-00135 5C

SCHELDT ESTUARY
Nitrogen Budget of the Scheldt Hydrographical Basin,
W89-00155 5B

Effects on the Benthic Fauna of Embanking an Intertidal Flat Area (The Markiezaat, Eastern Scheldt Estuary, The Netherlands),
W89-00676 6G

SCIENTIFIC PERSONNEL
Hydrological Perspective,
W89-01011 2A

SCOTLAND
Growth Strategies and Distribution of Isoetids in Scottish Freshwater Lochs,
W89-00129 5C

Ochre Deposits and Associated Bacteria in Some Field Drains in Scotland,
W89-00412 2G

Coastal Topography of the Moray Firth,
W89-00775 2L

Nature Conservation in the Moray Firth,
W89-00776 2L

Coastal Planning in the Moray Firth,
W89-00777 2L

Hydrography and Plankton of the Moray Firth,
W89-00778 2L

Exploited Fish and Shellfish Species in the Moray Firth,
W89-00779 2L

Intertidal Macrofauna of Nigg Bay,
W89-00780 2L

Moray Firth Marine Fouling Communities,
W89-00781 2L

Macrobenthos of the Beatrice Oilfield, Moray Firth, Scotland,
W89-00782 2L

Comparison of the Fauna Retained On 0.5 mm and 1.0 mm Meshes from Benthic Samples Taken in the Beatrice Oilfield, Moray Firth, Scotland,
W89-00783 2L

Sub-Littoral Fauna of the Inverness, Cromarty and Dornoch Firths,
W89-00784 2L

Oil Pollution in the Cromarty Firth and Inshore Moray Firth,
W89-00785 5B

Regulation of Pollution: Controls and Responsibilities,
W89-00786 6E

Monitoring the Moray Firth Environment,
W89-00787 5C

Pollution Control and Environmental Planning for the Beatrice Oilfield and Nigg Oil Terminal,
W89-00788 5G

SCOTLAND

Water Quality in the Inverness and Beauly Firths,
W89-00789 5B

Hydrocarbons in Nigg Bay Sediments,
W89-00790 5B

Hydrocarbon and Pollutant Levels in the Cromarty Firth,
W89-00791 5B

Degradation of Low-Toxicity Oil-Based Drilling Mud in Benthic Sediments around the Beatrice Oilfield,
W89-00792 5B

Future Prospects for Hydro Electricity and Windpower,
W89-00793 6C

Development of Mass Blooms of Photosynthetic Bacteria on Sheltered Beaches in Scapa Flow, Orkney Islands,
W89-00795 2L

Marine Pollution in Orkney,
W89-00796 5G

Sea and Fresh Waters,
W89-00797 2L

Geography of the Estuary and Firth of Clyde,
W89-00798 2L

Geological and Geomorphological Setting of the Estuary and Firth of Clyde,
W89-00799 2L

Climate of the Estuary and Firth of Clyde,
W89-00800 2L

Fresh Water Inflows to the Firth of Clyde,
W89-00801 2L

Clyde Sea Hydrography,
W89-00802 2L

Water Movement and the Simulation of Storm Surges in the Firth of Clyde,
W89-00803 2L

Effluent Disposal and the Physical Environment,
W89-00804 5E

Hydrography of Irvine Bay and Its Relation to the Clyde Sea Area,
W89-00805 2L

Bioturbation, Microbial Activity and Sediment Properties in an Estuarine Ecosystem,
W89-00806 2L

Attached Algae of the Clyde and Garnock Estuaries,
W89-00807 5C

Epilithic Diatoms of the Clyde Estuary,
W89-00808 2L

Recent Changes in Numbers of Waders on the Clyde Estuary, and Their Significance for Conservation,
W89-00810 5C

Patterns of Association Between Birds and Invertebrates in the Clyde Estuary,
W89-00811 2L

Phytoplankton Ecology of the Firth of Clyde Sea-Lochs Striven and Fyne,
W89-00813 2L

Zooplankton Investigations in the Firth of Clyde,
W89-00814 2L

Ecology of Macroalgae in the Firth of Clyde,
W89-00815 2L

Seaweed-Associated Animal Communities in the Firth of Clyde, with Special Reference to the Population Biology of the Amphipod Hyale nilssoni (Rathke),
W89-00816 2L

Long-Term Changes in Some Benthic Species in the Firth of Clyde, with Particular Reference to Tellina tenuis da Costa,
W89-00817 5C

Biology of Harpacticoid Copepods in the Meiofauna of Shallow Subtidal Sands,
W89-00818 2L

Benthic Fauna of Sandy Bays, with Particular Reference to Irvine Bay,
W89-00819 5C

Benthos of the Deeper Sediments of the Firth of Clyde, with Particular Reference to Organic Enrichment,
W89-00820 5C

Mud-Burrowing Megafauna of the Clyde Sea Area,
W89-00821 2L

Population Dynamics of Seabirds in the Firth of Clyde,
W89-00822 2L

Trace Metals in the Common Mussel Mytilus edulis (L.) in the Clyde Estuary,
W89-00823 5B

Use of the Clyde Estuary and Firth for the Disposal of Effluents,
W89-00824 5E

Biology and Management of Herring and Other Pelagic Fish Stocks in the Firth of Clyde,
W89-00825 2L

Recent Changes in the Status of Some Clyde Vertebrates,
W89-00826 5C

Conservation of Natural Resources,
W89-00827 6E

Migratory Salmonids of the Estuary and Firth of Clyde,
W89-00828 5G

Distribution of Plaice Eggs and Larvae in the Clyde Sea Area,
W89-00829 2L

Saltmarshes of the Firth of Clyde,
W89-00830 2L

Hydropower Development on Rivers in Scotland,
W89-00952 8C

SEA GRASSES

Correlations between Salinity and Growth of the Seagrass Amphibolis antarctica (Labill.) Sonder & Aschers., in Shark Bay, Western Australia, Using a New Method for Measuring Production Rate,
W89-00102 2L

Seasonal Abundance and Distribution of Drift Algae and Seagrasses in the Mid-Indian River Lagoon, Florida,
W89-00104 2L

Loss of Seagrass in Cockburn Sound, Western Australia: II. Possible Causes of Seagrass Decline,
W89-00116 5C

Model of Zostera marina L. Photosynthesis and Growth: Simulated Effects of Selected Physical-Chemical Variables and Biological Interactions,
W89-00130 2L

SEA ICE

Vertically Integrated Snow/Ice Model over Land/Sea for Climate Models: 1. Development,
W89-01260 2C

Vertically Integrated Snow/Ice Model over Land/Sea for Climate Models: 2. Impact on Orbital Change Experiments,
W89-01261 2C

SEA LEVEL

Extreme-Value Theory Model for Dependent Observations,
W89-01208 7C

SEA OF GALILEE

Trihalomethane Formation in High-Bromide Lake Galilee Water,
W89-00426 5F

SEA SURFACE

Toxicity of Sea-Surface Microlayer: Effects On Herring and Turbot Embryos,
W89-00855 5C

Contaminant Concentrations and Toxicity of Sea-Surface Microlayer Near Los Angeles, California,
W89-00857 5C

SEA SURFACE *WATER POLLUTION EFFECTS

Toxicity of Sea-Surface Microlayer: Effects of Hexane Extract on Baltic Herring (Clupea harengus) and Atlantic Cod (Gadus morhua) Embryos,
W89-00856 5C

SEA TROUT

Migratory Salmonids of the Estuary and Firth of Clyde,
W89-00828 5G

SEAGRASSES

Effects of Sediment Nutrients on Seagrasses: Literature Review and Mesocosm Experiment,
W89-00523 2L

SEAS

Sea Use Planning in Norwegian Waters: National and International Dimensions,
W89-00289 6E

SEASONAL DISTRIBUTION

Seasonal Abundance and Distribution of Drift Algae and Seagrasses in the Mid-Indian River Lagoon, Florida,
W89-00104 2L

Tintinnids and Other Microzooplankton - Seasonal Distributions and Relationships to Resources and Hydrography in a Maine Estuary,
W89-00223 2L

Seasonal Change of Iron and Manganese in Lake Fukami-ike: Occurrence of Turbid Manganese Layer,
W89-00770 2H

SEASONAL VARIATION

Seasonal and Short-Term Fluctuations in the Zooplankton Community of Paranoa Reservoir, Brasilia, Federal District, Brazil (Flutuacoes Sazonais e de Curta Duracao na Comunidade Zooplanktonica do Lago Paranoa, Brasilia-DF, Brasil),
W89-00006 2H

Oxygen Budget of a River in Submerged Macrophytes (River Zschopau in the South of the GDR),
W89-00137 2H

Seasonal Composition, Biomass and Primary Productivity of the Phytoplankton in Lakitelek Backwater during 1980 and 1983,
W89-00144 2H

Seasonal Changes of Phytoplankton in the Backwater Bokros,
W89-00147 2H

Evaluation of Seasonal Nutrient Dynamics in the Oosterschelde (SW Netherlands),
W89-00153 2L

Comparison of Nutrients in the Interstitial Water of Reducing (Tamar Estuary) and Oxic (Carmarthen Bay) Coastal Sediments,
W89-00156 2L

Seasonal Variations and Spatial Gradients of Nitrogenous Nutrients in Waters of Southeastern Vancouver Island, British Columbia, Canada.
W89-00158 2L

Clouds, Deep Chlorophyll Maxima and the Nutrient Supply to the Mixed Layer of Stratified Water Bodies,
W89-00227 2L

Short-Term Variations in the Zooplankton Community Related to Water Exchange Processes in the Gullmar Fjord, Sweden,
W89-00228 2H

Role of Storms in the Summer Succession of the Phytoplankton Community in a Shallow Lake (Lake Balaton, Hungary),
W89-00232 2H

Sedimentation of Phytoplankton Populations Dominated by Microcystis in a Shallow Lake,
W89-00233 2H

Climatography of Thunder Events in the Conterminous United States: Part I: Temporal Aspects,
W89-00274 2B

Climatography of Thunder Events in the Conterminous United States: Part II: Spatial Aspects,
W89-00275 2B

Effects of Season and Substrate on Availability of Drift for Fish in a Small Warmwater Stream,
W89-00400 2H

Algal Studies of the River Ely, South Wales, U.K.: I. Phytoplankton,
W89-00678 2H

Algal Studies of the River Ely, South Wales, U.K.: II. Epilithic Algae,
W89-00679 2H

Diurnal Changes of pH Distribution and the Cascading of Shore Water in a Sargassum Forest,
W89-00682 2L

Climate of the Estuary and Firth of Clyde,
W89-00800 2L

Seasonal Studies on the Phytoplankton and Primary Production in the Inner Firth of Clyde,
W89-00812 2L

Biology of Harpacticoid Copepods in the Meiofauna of Shallow Subtidal Sands,
W89-00818 2L

Interannual Variability in Climate and Fisheries in Tasmania,
W89-00847 2A

Seasonal Phytoplankton Demographic Processes and Experiments on Interspecific Competition,
W89-00906 2H

Large-Scale and Long-Term Variations in the Zooplankton Community of the Gullmar Fjord, Sweden, in Relation to Advective Processes,
W89-01038 2L

Patterns of Sulfate Reduction and the Sulfur Cycle in a South Carolina Salt Marsh,
W89-01046 2K

Vertically Integrated Snow/Ice Model over Land/Sea for Climate Models: 2. Impact on Orbital Change Experiments,
W89-01261 2C

SEASONAL VARIATIONS

Annual Cycle of Free-Floating Bacteria in the Bot River Estuary,
W89-00658 2L

Primary Production in the Orinoco River,
W89-00907 2H

Interspecific, Seasonal and Diel Variations in Zooplankton Trypsin and Amylase Activities in Kosterfjorden, Western Sweden,
W89-01040 2L

SEAWATER

Modelling Research on the Production Cycle of Phytoplankton in the Southern Bight of the North Sea in Relation to Riverborne Nutrient Loads,
W89-00157 2L

Determination of Gross-Beta Radioactivity in Water of the Changjiang River and Sea Water Near Its Entrance to Sea, (in Chinese),
W89-00534 2H

Studies on Marine Humic Substances: III. The Distribution of Humic Substances in Seawater and Sediments in the Estuary of Changjiang River and East China Sea, (in Chinese),
W89-00541 2L

Studies on Marine Humic Substances: IV. The Distribution of Humic Substances in the Seawater and Sediments of Huanghe River Estuary, (in Chinese),
W89-00545 2L

Experiments on Seawater Desalination by Membrane Distillation,
W89-01063 3A

SECONDARY WASTEWATER TREATMENT

Testing the Secondary Treatment of Effluents from the 'Police' Chemical Plant in Carp Ponds,
W89-00255 5D

Performance of Vinyl Core Media Trickling Filter Plant for Secondary Treatment of Municipal Wastewater,
W89-00502 5D

SECURITY

How Safe is Your Water Plant,
W89-00462 5F

SEDIMENT

Comparison of Methods for the Determination of Chlorophyll in Estuarine Sediments,
W89-00668 2L

SEDIMENT CARRYING CAPACITY

Suspension of Large Concentrations of Sands,
W89-00900 2J

SEDIMENT CONCENTRATION

Dynamic Modeling of Primary Sedimentation,
W89-00483 5D

SEDIMENT DISTRIBUTION

Determinations of Suspended Sediment Concentrations from Multiple Day Landsat and AVHRR Data,
W89-00064 7B

Landsat-MSS Radiance as a Measure of Suspended Sediment in the Lower Yellow River (Hwang Ho),
W89-00065 7B

Particulate Concentrations in Lake St. Clair as Recorded by a Shipborne Multispectral Optical Monitoring System,
W89-00066 7B

SEDIMENT LOAD

Solute Sources and Transport in an Ephemeral Badland Catchment, Southeastern Alberta, Canada,
W89-00046 2J

Sediment Transport of the Godavari River Basin and Its Controlling Factors,
W89-01211 2J

SEDIMENT TRANSPORT

Sedimentation of Phytoplankton Populations Dominated by Microcystis in a Shallow Lake,
W89-00233 2H

Sediment Delivery in a Semi-arid Coastal Stream,
W89-00346 2J

Sediment Transport and Bed Morphology at River Channel Confluences,
W89-00411 2J

Flow Regimes and Dynamic Equilibrium of Morphological Changes at Koycegiz Lake Inlet, Turkey,
W89-00449 8B

Hydrological Features of Poyang Lake (II), (in Chinese),
W89-00535 2H

Calculation of the Suspended Load in Rivers and Canals,
W89-00552 7B

Investigation of Transport-Processes along the Elbe River Using Chernobyl Radionuclides as Tracers,
W89-00636 5B

Barrier/Estuarine Processes. Bot River Estuary: An Interpretation of Aerial Photographs,
W89-00650 2L

Numerical Model for the Wind-Driven Circulation in the Bot River Estuary,
W89-00652 2L

Tidal Asymmetry and Estuarine Morphology,
W89-00670 2L

Methods for Estimating the Critical Shear Stress of Individual Fractions in Mixed-Size Sediment,
W89-00720 2J

Experimental Study of Incipient Motion in Mixed-Sized Sediment,
W89-00721 2J

Recent Transport of Metals in the River Severn as Recorded by the Sediments of Chelmarsh Reservoir, Shropshire, U.K.,
W89-00885 5B

Suspension of Large Concentrations of Sands,
W89-00900 2J

Channel Change and Sediment Transport in Regulated U.K. Rivers,
W89-00958 2J

Erosion and Sediment Yield Research: Some Recent Perspectives,
W89-01015 2J

Alluvial Channel Hydraulics,
W89-01017 2J

Measurement of Shallow Water Wave Direction for Longshore Sediment Transport,
W89-01082 2J

Sediment Transport of the Godavari River Basin and Its Controlling Factors,
W89-01211 2J

SEDIMENT-WATER INTERFACE
Sediment-Water Partition Coefficients and HPLC Retention Factors of Aromatic Hydrocarbons,
W89-00560 5B

SEDIMENT-WATER INTERFACES
Flocculent Settling above Zone Settling Interface,
W89-00484 5E

Sediment-Water Core Sampler for Coastal Pollution Studies,
W89-00641 5A

Dynamics of Dissolved Silicium and Nitrogen-Nutrients at Low Temperature in the EMS-Dollard Estuary,
W89-00673 2L

Interpretation of Metal Profiles in a Sediment Core from Lake Geneva: Metal Mobility or Pollution,
W89-00694 5B

SEDIMENT YIELD
Sediment Delivery in a Semi-arid Coastal Stream,
W89-00346 2J

Erosion and Sediment Yield Research: Some Recent Perspectives,
W89-01015 2J

SEDIMENTARY STRUCTURES
Sedimentary Environments and Facies of the Subtropical Mgeni Estuary, Southeast Africa,
W89-01084 2L

SEDIMENTATION
Suspended Matter and Bottom Deposits in the Mahury Estuarine System (French Guiana): Environmental Consequences,
W89-00003 2J

Effect of Sediment Depth and Sediment Type on the Survival of Vallisneria americana Michx Grown from Tubers,
W89-00114 2H

Sedimentation of Phytoplankton Populations Dominated by Microcystis in a Shallow Lake,
W89-00233 2H

Fluvial Sedimentation in the Ebb-Dominated Orange Estuary,
W89-00456 2J

Roles of Sedimentation and Plant Growth in Changing Flow Patterns in the Okavango Delta, Botswana,
W89-00457 2J

Dynamic Changes and Processes in the Mississippi River Delta,
W89-00469 2J

Flocculent Settling above Zone Settling Interface,
W89-00484 5E

Analysis of the Effects of Suspended Sediment of Huanghe River on Harbor Construction by Using NOAA Images, (in Chinese),
W89-00536 2J

Probing into the Computation Method on Sedimentary Amount of Poyang Lake, (in Chinese),
W89-00540 2H

Basin Sedimentation and the Growth of Prograding Deltas,
W89-00832 2J

Sedimentation of Particulate Material in Two Shallow, Land-Locked Fjords in Western Norway,
W89-01008 2J

Erosion and Sediment Yield Research: Some Recent Perspectives,
W89-01015 2J

Pelagic Ecosystem Model Simulating Production and Sedimentation of Biogenic Particles: Role of Salps and Copepods,
W89-01041 2L

SEDIMENTOLOGY
Geomorphology, Offshore Bathymetry and Quaternary Lithostratigraphy around the Bot River Estuary,
W89-00649 2L

Barrier/Estuarine Processes. Bot River Estuary: An Interpretation of Aerial Photographs,
W89-00650 2L

Synopsis of the Impact of Artificially Opening the Mouth of the Bot River Estuary: Implications for Management,
W89-00666 2L

Sediments in the Estuarine Environment of the Tigris/Euphrates Delta; Iraq; Arabian Gulf,
W89-01083 2L

SEDIMENTS
Contribution of Spartina alterniflora to the Pedra de Guaratiba (RJ) Salt Marsh Sediment Using Carbon-13 as a Tracer (Contribuicao de Materia Organica de Spartina alterniflora Para o Sedimento do Alagado de Pedra de Guaratiba (RJ): Uso de C13 como Tracador),
W89-00010 2L

Effect of Sediment Depth and Sediment Type on the Survival of Vallisneria americana Michx Grown from Tubers,
W89-00114 2H

Effects of Sediment Properties on Benthic Primary Production in the Columbia River Estuary,
W89-00115 2L

Determination of Organic Matter in River Sediments,
W89-00169 7B

Dynamics of Iron and Manganese in the Surface Sediments of a Seasonally Anoxic Lake,
W89-00188 2H

Chemical Behavior of Metal Elements in the Sediments in the Hanjiang River Estuary and Shantou Port, (in Chinese),
W89-00202 2L

Distribution of Agglutinated Foraminifera in Bottom Sediments of the Zhujiang River Estuary, (in Chinese),
W89-00203 2L

Sorption Properties of Bottom Sediments of Szczytno Male and Letowo Lakes,
W89-00256 2H

Differentiation of the Physical and Chemical Properties of Bottom Sediments in Phytocenoses of Myriophylletum verticillati Soo 1927, Potamogetonetum natantis Soo 1927 and Hydrocharitetum morsus-ranae Langendonck 1935 Associations,
W89-00259 2H

Fate of Spent Bleach Liquor Material in Receiving Waters: Characterization of Chloroorganics in Sediments,
W89-00371 5B

Influence of Selected Organic Complexing Agents on the Sorption of Heavy Metals in River Sediments (Einfluss Ausgewaehlter Organischer Komplexbildner auf die Sorption von Schwermetallen an Gewaessersedimente),
W89-00501 5B

Effects of Sediment Nutrients on Seagrasses: Literature Review and Mesocosm Experiment,
W89-00523 2L

Studies on Marine Humic Substances: III. The Distribution of Humic Substances in Seawater and Sediments in the Estuary of Changjiang River and East China Sea, (in Chinese),
W89-00541 2L

Studies on Marine Humic Substances: IV. The Distribution of Humic Substances in the Seawater and Sediments of Huanghe River Estuary, (in Chinese),
W89-00545 2L

Polybrominated Biphenyl Ethers in Marine Fish, Shellfish, and River and Marine Sediments in Japan,
W89-00610 5B

Chlorinated Hydrocarbons in Sediments of the Elbe River and the Elbe Estuary,
W89-00614 5B

Contributions of Heavy Metals from Municipal Runoff to the Sediments of Lake Pontchartrain, Louisiana,
W89-00618 5B

Sequential Extraction of Phosphorus and Heavy Metals from Sediments: Methodological Considerations,
W89-00629 5A

Sediment-Water Core Sampler for Coastal Pollution Studies,
W89-00641 5A

Distribution of Arsenic in the Sediments and Biota of Hilo Bay, Hawaii,
W89-00677 5B

Polyethylene Glycol Precipitation for Recovery of Pathogenic Viruses, Including Hepatitis A Virus and Human Rotavirus, from Oyster, Water, and Sediment Samples,
W89-00730 5A

Relationship between Nitrogen-Fixing Sulfate Reducers and Fermenters in Salt Marsh Sediments and Roots of Spartina alterniflora,
W89-00732 2L

Sediment Analysis: Lability of Selectively Extracted Fractions,
W89-00744 5A

Hydrocarbons in Nigg Bay Sediments,
W89-00790 5B

Bioturbation, Microbial Activity and Sediment Properties in an Estuarine Ecosystem,
W89-00806 2L

Laboratory Study of the Accumulation and Toxicity of Contaminants at the Sea Surface from Sediments Proposed for Dredging,
W89-00858 5E

Numerical Modeling of Sorption Kinetics of Organic Compounds to Soil and Sediment Particles,
W89-00981 5B

Sorption and Desorption Dynamics of Aroclor 1242 to Natural Sediment,
W89-00991 5B

Influence of Microphytobenthos on the Nutrient Flux between Sediment and Water: A Laboratory Study,
W89-01036 2L

Active Emergence of Meiofauna from Intertidal Sediment,
W89-01037 2L

Spatial Patchiness in the Lacustrine Sedimentary Environment,
W89-01048 2H

Accumulation of Polycyclic Aromatic Hydrocarbons in Acid Sensitive Lakes,
W89-01074 5B

Trace Metal Geochemistry of Pore Water Brines from Two Hypersaline Lakes,
W89-01079 2K

Sediments in the Estuarine Environment of the Tigris/Euphrates Delta; Iraq; Arabian Gulf,
W89-01083 2L

Sedimentary Environments and Facies of the Subtropical Mgeni Estuary, Southeast Africa,
W89-01084 2L

Sorption of Cationic Oligomers on Sediments,
W89-01094 5B

Comparison of Three Sediment Bioassay Methods Using Detroit River Sediments,
W89-01097 5A

Estimating Soil/Sediment Partition Coefficients for Organic Compounds by High Performance Reverse Phase Liquid Chromatography,
W89-01223 5B

SEEDS

Seed Germination Traits of Annuals and Emergents Recruited during Drawdowns in the Delta Marsh, Manitoba, Canada,
W89-00126 2H

SEEPAGE

Concerning Certain Studies on Seepage and Dissolution of Salts in the Foundation of Dams,
W89-00062 10C

Effect of Seepage on Earth Dams,
W89-00550 8D

Steady Unsaturated Seepage above a Sloping Impermeable Base,
W89-00726 2G

Stability of Sand Slopes in the Groundwater Discharge Zones,
W89-01174 8D

SEISMIC PROPERTIES

Seismic Stress State of Underground Structures with Consideration of the Effect of the Free Surface,
W89-00035 8E

Calculation of Seismic Safety of Tunnels During Blasting,
W89-00037 8E

Transient Pressures in Hydrotechnical Tunnels During Earthquakes,
W89-00448 8E

Estimation of the Reliability of Earth Dams with Consideration of Seismic Loads,
W89-00557 8E

SELENIUM

Negative Thermal Ionization Mass Spectrometry of Selenium: Part 1. Isotope Ratio Measurements and Determinations in Aquatic Systems with the Isotope Dilution Technique (Negative Thermionen-Massenspektrometrie von Selen: Teil 1. Isotopenverhaeltnismessungen sowie Konzentrationsbestimmungen in Aquatischen Systemen mit der Isotopenverduennungsanalyse),
W89-00737 5A

Assessment of Selenium Toxicity in Algae Using Turbidostat Culture,
W89-01230 5C

SEMIARID CLIMATES

Problems of Rainfall-Runoff Modelling in Arid and Semiarid Regions,
W89-01144 2E

SEMIARID LANDS

Sediment Delivery in a Semi-arid Coastal Stream,
W89-00346 2J

SENSITIVITY ANALYSIS

Sensitivity Analysis of Closed-Form Analytical Hydraulic Conductivity Models,
W89-01204 2G

SEPARATION TECHNIQUES

Continuous-flow System for the Determination of Cobalt in Sea and River Water: In-line Preconcentration/Separation Coupled with Catalytic Determination,
W89-00063 5A

Efficacy of Chemical Dosing Methods for Isolating Nontuberculous Mycobacteria from Water Supplies of Dialysis Centers,
W89-00343 5A

SEPTIC TANKS

Innovative Septic System Management,
W89-00508 5D

Septic System Performance on a Coastal Barrier Island,
W89-01163 5D

Transport Modelling of Biological Tracers from Septic Systems,
W89-01226 5B

SESTON

Drift of Zooplankton in a Lake-Outlet (Glatt) in a Day-Night-Rhythm Depending from the Water Level,
W89-00025 2H

Particulate Concentrations in Lake St. Clair as Recorded by a Shipborne Multispectral Optical Monitoring System,
W89-00066 7B

Diurnal Fluctuations of Phosphorus Forms in Lake Water and Seston in Pluss-See,
W89-00246 2H

SEVERN RIVER

Hydrological Changes and the River Regulation in the UK,
W89-00957 4A

SEWER HYDRAULICS

Mobile Flume for Circular Channel,
W89-00757 7B

SEWERS

Effect of Sulfate and Organic Matter on The Hydrogen Sulfide Formation in Biofilms of Filled Sanitary Sewers,
W89-00510 5D

Evaluation of Chemical Oxidizers for Hydrogen Sulfide Control,
W89-01129 5D

SHALLOW WATER

New Aspects of the Sulfur Cycle, with Special Reference to Shallow Waters,
W89-00183 5B

Effects of Disturbance and Severe Seasonal Fluctuations in Environmental Conditions on North Temperate Shallow-water Fish Assemblages,
W89-00282 2L

Intercomparison of Four Mixed Layer Models in a Shallow Inland Sea,
W89-00831 2H

Measurement of Shallow Water Wave Direction for Longshore Sediment Transport,
W89-01082 2J

SHANTOU PORT

Chemical Behavior of Metal Elements in the Sediments in the Hanjiang River Estuary and Shantou Port, (in Chinese),
W89-00202 2L

SHEAR STRESS

Shear Instability in a Highly Stratified Estuary,
W89-00415 2L

Methods for Estimating the Critical Shear Stress of Individual Fractions in Mixed-Size Sediment,
W89-00720 2J

Experimental Study of Incipient Motion in Mixed-Sized Sediment,
W89-00721 2J

SHEAR TESTS

Laboratory Analysis of Mudflow Properties,
W89-00899 2J

SHEEPSHEAD MINNOW

Effects of Cadmium on Early Developmental Stages of the Sheepshead Minnow (Cyprinodon Variegatus),
W89-01091 5C

SHELLFISH

Routine Determination of Polychlorinated Biphenyl Residues in Fish and Shellfish in Taipei County,
W89-00605 5A

Polybrominated Biphenyl Ethers in Marine Fish, Shellfish, and River and Marine Sediments in Japan,
W89-00610 5B

Population Genetics of Mytilus edulis (L.) from Oslofjorden, Norway in Oil-Polluted and Non Oil-Polluted Water,
W89-01009 5C

SHENANGO RIVER

Unionid (Mollusca:Bivalvia) Fauna of the Shenango River in Mercer County, Pennsylvania,
W89-00312 5C

SHORE PROTECTION

Great Lakes Shore Erosion,
W89-00133 4D

SHORTWAVE ALBEDO

Comparison of Model-Generated and Satellite-derived Cloud Cover and Radiation Budget,
W89-01262 2A

SHRIMP

Recurrence of Daphnia rosea in Lake Tahoe: Analysis of a Population Pulse,
W89-00216 2H

SIERRA NEVADA

Hydrogen Ion Concentration and Alkalinity of Reservoir Water in the Sierra Nevada, California, and Correlations with Air Pollutants,
W89-01165 5B

SILICONES

Studies of the Oxidative Photoinduced Degradation of Silicones in the Aquatic Environment,
W89-00617 5B

SILVER IODIDE
Secondary Ice Nucleus Generation by Silver Iodide Applied to the Ground,
W89-00088 3B

Persistent Effects of Cloud Seeding with Silver Iodide,
W89-00091 3B

SIMULATED RAINFALL
Effects of Simulated Acidic Precipitation on Plant-Insect Interactions in Agricultural Systems: Corn and Black Cutworm Larvae,
W89-01160 5C

SIMULATION
Flow Simulation Using Channel Network Model,
W89-00751 7B

Evaluating Peat-Mining Hydrology Using DRAINMOD,
W89-00755 4C

Simulation Model for Biotransformation of Xenobiotics and Chemotaxis in Soil Columns,
W89-00989 5B

SIMULATION ANALYSIS
Model of Zostera marina L. Photosynthesis and Growth: Simulated Effects of Selected Physical-Chemical Variables and Biological Interactions,
W89-00130 2L

General Water Supply System Simulation Model: WASP,
W89-00299 5F

Urban Runoff Simulation Model,
W89-00301 2E

Linear Root Water Uptake Model,
W89-00353 2I

River Basin Water Quality Management in Stochastic Environment,
W89-00490 5G

Alternative Strategies for Stormwater Detention,
W89-00875 4A

Simulation of Regional Ground Water Flow in Bedrock, Southwestern New York-Northwestern Pennsylvania,
W89-00882 2F

Waste Allocation Simulation Models,
W89-01234 5D

Analytical Simulation of Water System Capacity Reliability: 1. Modified Frequency-Duration Analysis,
W89-01240 5F

Analytical Simulation of Water System Capacity Reliability: 2. A Markov Chain Approach and Verification of the Models,
W89-01241 5F

SKELETONEMA
Effect of Light Regime upon Growth Rate and Chemical Composition of a Clone of Skeletonema costatum from the Trondheimsfjord, Norway,
W89-00212 2L

SLIME
Apparatus for Assessing Sulfide Generation Rates from Sewer Slimes,
W89-00497 5D

SLOPE DEGRADATION
Records of Riverborne Turbidity Currents and Indications of Slope Failures in the Rhone Delta of Lake Geneva,
W89-01049 2J

SLOPE STABILITY
Selection of a Method for Computer-aided Design of Earth Dams,
W89-00056 8D

Stability of Sand Slopes in the Groundwater Discharge Zones,
W89-01174 8D

SLOPES
Water Flow in Layered Soils with Sloping Surface,
W89-00752 2G

Hillslope Runoff Processes and Models,
W89-01022 2A

Impact of Rainfall and Soil Hydraulic Property Information on Runoff Predictions at the Hillslope Scale,
W89-01246 2E

SLUDGE
Soft Bottom Fauna Near the River Elbe Estuary under the Influence of Sewage Sludge. I. Seasonal Variation of Species Number, Abundance and Biomass in Relation to Sediment Structure (Die Weichbodenfauna vor der Elbemuendung unter dem Einfluss der Klaerschlammverklappung. I. Die Saisonale Veraenderung von Arten- und Individuenzahl sowie Biomasse unter Beruecksichtigung der Sedimentstrucktur),
W89-00316 5C

Soil Solution in a Soil Treated with Digested Sewage Sludge,
W89-00413 5B

Land Application of Domestic Wastewater, Wood Production, and Sludge Composting: An Economic and Energy Production Analysis,
W89-00465 5E

Movement of Sludge through Conveyor Centrifuge,
W89-00485 5D

Properties of Water Treatment Lime Sludges and Their Effectiveness as Agricultural Limestone Substitutes,
W89-00516 5F

Comparison of Co-Digestion Performance of Two Differently Collected Organic Fractions of Municipal Solid Waste with Sewage Sludges,
W89-00643 5D

Detection of Environmental Viruses in Sludge: Enhancement of Enterovirus Plaque Assay Titers with 5-Iodo-2'-Deoxyuridine and Comparison to Adenovirus and Coliphage Titers,
W89-01220 5A

SLUDGE BED
Anaerobic Treatment of Leachate Using Fixed Film and Sludge Bed Systems,
W89-01238 5D

SLUDGE CAKE
Compressible Cake Filtration: Monitoring Cake Formation and Shrinkage Using Synchrotron X-rays,
W89-00512 5D

SLUDGE DIGESTION
Assessment of the Toxicity of Heavy Metals to the Anaerobic Digestion of Sewage Sludge,
W89-00631 5D

Comparison of Co-Digestion Performance of Two Differently Collected Organic Fractions of Municipal Solid Waste with Sewage Sludges,
W89-00643 5D

SLUDGE DISPOSAL
Soil Solution in a Soil Treated with Digested Sewage Sludge,
W89-00413 5B

Properties of Water Treatment Lime Sludges and Their Effectiveness as Agricultural Limestone Substitutes,
W89-00516 5F

Emissions of Chlorinated Organics from a Municipal Sewage Sludge Burning Incinerator,
W89-00607 5B

Benthos of the Deeper Sediments of the Firth of Clyde, with Particular Reference to Organic Enrichment,
W89-00820 5C

Copper, Nickel, and Chrome Recovery in a Jobshop to Eliminate Waste Treatment and Sludge Disposal,
W89-00993 5D

Design Criteria for In-Situ and On-Site Renovation of an Industrial Sludge Lagoon,
W89-00996 5B

Disposal of Radium Removed from Drinking Water,
W89-01106 5E

Operating a Small Full-Scale Ion Exchange System for Uranium Removal,
W89-01107 5F

Assessing Effects of Soil Pollution Control Residuals on Soil Chemistry Properties,
W89-01140 5E

Sewage Sludge-Soil Interactions as Measured by Plant and Soil Chemical Composition,
W89-01161 5E

SLUDGE DRYING
Movement of Sludge through Conveyor Centrifuge,
W89-00485 5D

SLUDGE LAGOONS
Design Criteria for In-Situ and On-Site Renovation of an Industrial Sludge Lagoon,
W89-00996 5B

SLUDGE SOLIDS
Leaching of Inorganic Hazardous Constituents from Stabilized/Solidified Hazardous Wastes,
W89-00999 5E

SLUDGE TREATMENT
Sequential Wet Air Regeneration of PAC from the Powdered Carbon-Activated Sludge Process,
W89-01137 5D

SLUDGE UTILIZATION
Sewage Sludge-Soil Interactions as Measured by Plant and Soil Chemical Composition,
W89-01161 5E

Possible Mechanism for Manganese Phytotoxicity in Hawaii Soils Amended with a Low-Manganese Sewage Sludge,
W89-01169 5E

SMALL WATER SYSTEMS
SDWA Amendments: Small Community Compliance,
W89-01112 6E

Financing Strategies for Small Systems,
W89-01113 5F

AWWA Small Systems Program,
W89-01114 5F

Source Protection and the Small Utility,
W89-01116 5G

New Regulations: A Challenge for Small Systems,
W89-01118 5F

SMALL WATERSHEDS
Vertical Variability of Soil Properties in a Small Watershed,
W89-00354 2G

Enhancement of Runoff From a Small Watershed by Cloud Seeding,
W89-01212 3B

SMALLMOUTH BASS
Application of Ecological Modelling: Impact of Thermal Effluent on a Smallmouth Bass Population,
W89-00317 5C

SMELTERS
Changes in Rainwater Acidity Associated with Closure of a Copper Smelter,
W89-00272 5B

SMOKY HILL RIVER
Variations of Runoff in the High Plains Section of the Smoky Hill Drainage, 1951-1980,
W89-00394 2A

SNAILS
Study of the Temperature Dependence of the Acute Toxicity of Pentachlorophenol to a Freshwater Pond Snail, Viviparus bengalensis L.,
W89-00078 5C

Effect of Several Methods of Aquatic Plant Control on Two Bilharzia-Bearing Snail Species,
W89-00117 4A

Snail Distributions in Lake Erie: The Influence of Anoxia in the Southern Central Basin Nearshore Zone,
W89-00683 2A

Sensitivity of Freshwater Pulmonate Snails, Lymnaea luteola L., to Heavy Metals,
W89-01154 5C

Uptake and Distribution of Copper Sulphate and Its Effect on the Respiration Rate of the Hemocyanin-Producing Freshwater Snail Lymnaea natalensis,
W89-01155 5G

SNOW
Determination of Nitrate at the Ng/g Level in Antarctic Snow Samples with Ion Chromatography and Isotope Dilution Mass Spectrometry,
W89-00269 5A

Determination of Heavy Metals at the Pg/g Level in Antarctic Snow with DPASV and IDMS,
W89-00270 5A

Relationship Between delta-D and delta-18-O Values of Falling Snow Particles from a Separate Cloud,
W89-00406 2C

Mesoscale Spiral Vortex Embedded within a Lake Michigan Snow Squall Band: High Resolution Satellite Observations and Numerical Model Simulations,
W89-00748 2B

Vertically Integrated Snow/Ice Model over Land/Sea for Climate Models: 1. Development,
W89-01260 2C

Vertically Integrated Snow/Ice Model over Land/Sea for Climate Models: 2. Impact on Orbital Change Experiments,
W89-01261 2C

SNOW SAMPLING
Nitrate Trace Determinations in Snow and Firn Core Samples of Ice Shelves at the Weddell Sea, Antarctica,
W89-01258 5B

SNOWMELT
Progress in Developing an Operational Snowmelt-Runoff Forecast Model with Remote Sensing Input,
W89-00891 2A

Acidification of Shallow Groundwaters During the Spring Melt Period,
W89-00893 5B

Approximate Confidence Intervals for Verification Criteria of the WMO Intercomparison of Snowmelt Runoff Models,
W89-01143 2E

Prediction of Snowmelt Rates in a Deciduous Forest,
W89-01203 2C

SOCIAL ADJUSTMENT
Effects of Rate Structure Knowledge on Household Water Use,
W89-00877 6D

SOCIAL ASPECTS
Look to the Future: Environmental Education,
W89-01121 5G

SOCIAL VALUES
Technology, Institutions, and Social Goals,
W89-00871 6D

SODIUM CHLORIDE
Tisza Water, as Irrigation Water, Polluted with Various Compounds,
W89-00145 3C

SODIUM PENTACHLOROPHENATE
Growth and Conversion Efficiency of the Catfish Heteropneustes fossilis (Bloch) Exposed to Sub-Lethal Concentrations of Sodium Pentachlorophenate,
W89-00243 5C

SOIL ABSORPTION CAPACITY
Extension of the Fujita Solution to Air and Water Movement in Soils,
W89-00725 2G

SOIL AMENDMENTS
Properties of Water Treatment Lime Sludges and Their Effectiveness as Agricultural Limestone Substitutes,
W89-00516 5F

Possible Mechanism for Manganese Phytotoxicity in Hawaii Soils Amended with a Low-Manganese Sewage Sludge,
W89-01169 5E

SOIL ANALYSIS
Determination of Thiram in Water and Soils by Cathodic Stripping Voltammetry Based on Adsorptive Accumulation,
W89-01087 5A

SOIL BACTERIA
Ochre Deposits and Associated Bacteria in Some Field Drains in Scotland,
W89-00412 2G

Simulation Model for Biotransformation of Xenobiotics and Chemotaxis in Soil Columns,
W89-00989 5B

SOIL CHEMISTRY
Soil Processes and Sulfate Loss at the Hubbard Brook Experimental Forest,
W89-00206 5B

Changes in Soil Acidity in Two Forest Areas with Different Acid Deposition: 1920s to 1980s,
W89-00444 5B

Simulation Model for Biotransformation of Xenobiotics and Chemotaxis in Soil Columns,
W89-00989 5B

Assessing Effects of Soil Pollution Control Residuals on Soil Chemistry Properties,
W89-01140 5E

Sewage Sludge-Soil Interactions as Measured by Plant and Soil Chemical Composition,
W89-01161 5E

Effects of Leaching and Whole-Tree Harvesting on Cation Budgets of Several Forests,
W89-01166 4C

Possible Mechanism for Manganese Phytotoxicity in Hawaii Soils Amended with a Low-Manganese Sewage Sludge,
W89-01169 5E

SOIL CONTAMINATION
Immobilization of Leachable Toxic Soil Pollutants by Using Oxidative Enzymes,
W89-00341 5G

Characteristics of Soil after Pollution with Waste Waters from Olive Oil Extraction Plants,
W89-00602 5C

Long-term Study of Ecosystem Contamination with 2,3,7,8-Tetrachlorodibenzo-p-dioxin,
W89-00603 5B

Transport of Solutes in Soils and Aquifers,
W89-01027 5B

Assessing Effects of Soil Pollution Control Residuals on Soil Chemistry Properties,
W89-01140 5E

Estimating Soil/Sediment Partition Coefficients for Organic Compounds by High Performance Reverse Phase Liquid Chromatography,
W89-01223 5B

Fate and Transport of Organics in Soil: Model Predictions and Experimental Results,
W89-01239 5B

SOIL ENGINEERING
Excavation of Heavy Soils by Dredges,
W89-00068 8H

SOIL EROSION
Dempster's Rule of Combination in Soil-Loss Prediction,
W89-00303 2J

Effect of Sodium Nitrate and Gypsum on Infiltration and Erosion of a Highly Weathered Soil,
W89-00409 2G

SOIL GASES
Extension of the Fujita Solution to Air and Water Movement in Soils,
W89-00725 2G

SOIL HORIZONS
Changes in Soil Acidity in Two Forest Areas with Different Acid Deposition: 1920s to 1980s,
W89-00444 5B

Water Flow in Layered Soils with Sloping Surface,
W89-00752 2G

SOIL LOSS
Erosion and Sediment Yield Research: Some Recent Perspectives,
W89-01015 2J

SOIL MOISTURE METERS
Improved Methodology for a Collinear Dual-Energy Gamma Radiation System,
W89-00985 7B

SOIL ORGANIC MATTER
Role of Soil Organic Matter in the Geochemical Cycling of Chloride and Bromide,
W89-01200 2A

SOIL PHYSICAL PROPERTIES
Assignment of the Characteristics of Clay-Rubble Soils in Watertight Components of Earth Dams,
W89-00036 8D

Vertical Variability of Soil Properties in a Small Watershed,
W89-00354 2G

Effect of Sodium Nitrate and Gypsum on Infiltration and Erosion of a Highly Weathered Soil,
W89-00409 2G

SOIL PHYSICS
Soil Physics and Hydrology,
W89-01026 2G

SOIL PROFILES
Explicit Solution to Green-Ampt Equation for Nonuniform Soils,
W89-00760 7B

SOIL PROPERTIES
Procedure for Evaluating Municipal Solid Waste Leachate Components Capable of Causing Volume Shrinkage in Compacted Clay Soils,
W89-00621 5E

Extension of the Fujita Solution to Air and Water Movement in Soils,
W89-00725 2G

Impact of Rainfall and Soil Hydraulic Property Information on Runoff Predictions at the Hillslope Scale,
W89-01246 2E

SOIL SEALANTS
Horizontal Infiltration of Water in Soil Columns as Affected by a Gel-Forming Conditioner,
W89-00741 2G

SOIL SOLUTION
Soil Solution in a Soil Treated with Digested Sewage Sludge,
W89-00413 5B

SOIL TEMPERATURE
Sorption and Degradation of Aldicarb and Its Oxidation Products in a Soil-Water Flow System as a Function of pH and Temperature,
W89-01164 5B

SOIL TREATMENT
Soil Solution in a Soil Treated with Digested Sewage Sludge,
W89-00413 5B

SOIL WATER
Air and Water Flow: I. Horizontal Flow with an Arbitrary Flux Boundary Condition,
W89-00347 2G

Estimation of Bare Soil Evaporation from Airborne Measurements,
W89-00352 7B

Subsoil Investigation of Ice Lensing at the Calgary, Canada, Frost Heave Test Facility,
W89-00389 2C

Effect of Assumed Unit Gradient During Drainage on the Determination of Unsaturated Hydraulic Conductivity and Infiltration Parameters,
W89-00407 2G

Intrapedal Macropore Distribution and Infiltration Rate of Three Friona Polypedons,
W89-00408 2G

Ochre Deposits and Associated Bacteria in Some Field Drains in Scotland,
W89-00412 2G

Modified Fickian Model for Solute Uptake by Runoff,
W89-00486 5B

Hydrogeological and Hydrogeochemical studies of the Unsaturated Flow in a Gravel Aquifer: Part II. Results of Long Term Soil-hydrological Measurements (Hydrogeologische und Hydrochemische Untersuchungen in der Ungesaettigten Zone eines Kiesgrundwasserleiters: Teil II. Ergebnisse Langjaehriger Bodenhydrologischer Messungen),
W89-00503 2F

Multiple Reflection and Attenuation of Time Domain Reflectometry Pulses: Theoretical Considerations of Applications to Soil and Water,
W89-00701 7B

Determination of Electrical Conductivity Using Time Domain Reflectometry: Soil and Water Experiments in Coaxial Lines,
W89-00702 2G

Extension of the Fujita Solution to Air and Water Movement in Soils,
W89-00725 2G

Infiltration under Ponded Conditions: 2. Infiltration Equations Tested for Parameter Time-Dependence and Predictive Use,
W89-00740 2G

Horizontal Infiltration of Water in Soil Columns as Affected by a Gel-Forming Conditioner,
W89-00741 2G

Subsurface Drainage Peak Flows in Shallow Soil,
W89-00749 4A

Water Flow in Layered Soils with Sloping Surface,
W89-00752 2G

Explicit Solution to Green-Ampt Equation for Nonuniform Soils,
W89-00760 7B

Productivity and Nutrient Cycling of Alaskan Tundra: Enhancement by Flowing Soil Water,
W89-00908 2G

Comparison of Two Methods for Summarizing Hydraulic Conductivities of a Layered Soil,
W89-00970 2G

Improved Methodology for a Collinear Dual-Energy Gamma Radiation System,
W89-00985 7B

Modelling Soil Water Dynamics in the Unsaturated Zone: State of the Art,
W89-01014 2G

Tracing of Water Movement in the Unsaturated Zone Using Stable Isotopes of Hydrogen and Oxygen,
W89-01016 2G

Soil Physics and Hydrology,
W89-01026 2G

Sorption and Degradation of Aldicarb and Its Oxidation Products in a Soil-Water Flow System as a Function of pH and Temperature,
W89-01164 5B

Effects of Leaching and Whole-Tree Harvesting on Cation Budgets of Several Forests,
W89-01166 4C

Sensitivity Analysis of Closed-Form Analytical Hydraulic Conductivity Models,
W89-01204 2G

SOIL-WATER-PLANT RELATIONSHIPS
Linear Root Water Uptake Model,
W89-00353 2I

Does Transpiration Limit the Growth of Vegetation or Vice Versa,
W89-01013 2I

Sewage Sludge-Soil Interactions as Measured by Plant and Soil Chemical Composition,
W89-01161 5E

Possible Mechanism for Manganese Phytotoxicity in Hawaii Soils Amended with a Low-Manganese Sewage Sludge,
W89-01169 5E

SOIL WATER TABLE
Shallowly Placed, Low Pressure Distribution System to Treat Domestic Wastewater in Soils with Fluctuating High Water Tables,
W89-01171 5D

SOILL PROFILES
Comparison of Two Methods for Summarizing Hydraulic Conductivities of a Layered Soil,
W89-00970 2G

SOLAR RADIATION
Influence of Sediment Composition and Irradiance on the Growth and Morphology of Myriophyllum spicatum L.,
W89-00098 2H

SOLE
Hepatic Lesions in English Sole (Parophrys vetulus) from Commencement Bay, Washington (USA),
W89-00859 5C

SOLID WASTES
Comparison of Co-Digestion Performance of Two Differently Collected Organic Fractions of Municipal Solid Waste with Sewage Sludges,
W89-00643 5D

Transmission Electron Microscopic Study of Solidified/Stabilized Organics,
W89-01000 5E

SOLUBILITY
Solubilities of Trace Copper and Lead Species and the Complexing Capacity of River Water in the Linggi River Basin,
W89-00084 5B

Solubility of Colloidal Ferric Hydroxide and its Relevance to Iron Concentrations in River Water,
W89-01081 2K

SOLUTE TRANSPORT
Solute Sources and Transport in an Ephemeral Badland Catchment, Southeastern Alberta, Canada,
W89-00046 2J

Influence of the Vistula River on Distribution of 226Ra in the Gdansk Bay,
W89-00250 2K

Chemical Mechanisms of Heavy Metal Transport in Waters of Mala Panew and Brynica Rivers (Silesia, Poland),
W89-00251 5B

Changes in Rainwater Acidity Associated with Closure of a Copper Smelter,
W89-00272 5B

Modified Fickian Model for Solute Uptake by Runoff,
W89-00486 5B

Dispersion in Heterogeneous Porous Media: 1. Local Volume Averaging and Large-Scale Averaging,
W89-00699 5B

Dispersion in Heterogeneous Porous Media: 2. Predictions for Stratified and Two-Dimensional Spatially Periodic Systems,
W89-00700 5B

Three-Dimensional Radial Dispersion in a Variable Velocity Flow Field,
W89-00715 5B

Microscale Haline Convection - A Proposed Mechanism for Transport and Mixing at the Water Table Region,
W89-00718 2F

Theoretical Analysis of Deviations from Local Equilibrium During Sorbing Solute Transport Through Idealized Stratified Aquifers,
W89-00987 5B

Sorption Nonequilibrium During Solute Transport,
W89-00988 5B

Groundwater Flow and Transport Modeling,
W89-01025 2F

Transport of Solutes in Soils and Aquifers,
W89-01027 5B

Influence of Microphytobenthos on the Nutrient Flux between Sediment and Water: A Laboratory Study,
W89-01036 2L

Annual Elemental Input/Output Estimates for Two Forested Watersheds in Eastern Tennessee,
W89-01168 5B

Time-Dependent Macrodispersion for Solute Transport in Anisotropic Heterogeneous Aquifers,
W89-01245 2F

SONORA

Multicriterion Selection of Wastewater Management Alternatives,
W89-00300 5D

SORPTION

Sorption of Cations by Bottom Sediments of Szczytno Male and Letowo Lakes, with Cage Trout Culture,
W89-00239 2H

Sorption Properties of Bottom Sediments of Szczytno Male and Letowo Lakes,
W89-00256 2H

Air and Water Flow: I. Horizontal Flow with an Arbitrary Flux Boundary Condition,
W89-00347 2G

Removal of Cadmium using Chitosan,
W89-00496 5D

Sorption of Hydrophobic Chemicals from Water: A Hypothesis for the Mechanism of the Particle Concentration Effect,
W89-00585 5B

Evaluation of Disposable Membrane Filter Units for Sorptive Losses and Sample Contamination,
W89-00623 5A

Application of Biologically Activated Sorptive Columns for Textile Waste Water Treatment,
W89-00632 5D

Nonaqueous Phase Liquid Transport and Cleanup: I. Analysis of Mechanisms,
W89-00968 5B

Numerical Modeling of Sorption Kinetics of Organic Compounds to Soil and Sediment Particles,
W89-00981 5B

Theoretical Analysis of Deviations from Local Equilibrium During Sorbing Solute Transport Through Idealized Stratified Aquifers,
W89-00987 5B

Sorption Nonequilibrium During Solute Transport,
W89-00988 5B

Sorption and Desorption Dynamics of Aroclor 1242 to Natural Sediment,
W89-00991 5B

Sorption of Cationic Oligomers on Sediments,
W89-01094 5B

Sorption and Degradation of Aldicarb and Its Oxidation Products in a Soil-Water Flow System as a Function of pH and Temperature,
W89-01164 5B

Estimating Soil/Sediment Partition Coefficients for Organic Compounds by High Performance Reverse Phase Liquid Chromatography,
W89-01223 5B

SOUTH AFRICA

Flux of Organic Carbon in a Tidal Salt Marsh, Kowie River Estuary, Port Alfred, South Africa,
W89-00453 2L

Rain Acidity in Stellenbosch,
W89-00454 5A

Fluvial Sedimentation in the Ebb-Dominated Orange Estuary,
W89-00456 2J

Roles of Sedimentation and Plant Growth in Changing Flow Patterns in the Okavango Delta, Botswana,
W89-00457 2J

Spatial Patterns of N Fixation (Acetylene Reduction) along Environmental Gradients in a Warm-Temperate Estuary,
W89-00475 2L

Geomorphology, Offshore Bathymetry and Quaternary Lithostratigraphy around the Bot River Estuary,
W89-00649 2L

Barrier/Estuarine Processes. Bot River Estuary: An Interpretation of Aerial Photographs,
W89-00650 2L

Numerical Model for the Wind-Driven Circulation in the Bot River Estuary,
W89-00652 2L

Historical Records of the Bot River Estuarine System,
W89-00653 2L

Hydrology of the Bot River Estuary,
W89-00654 2L

Physical and Chemical Characteristics of the Waters of the Bot River Estuary, South Africa,
W89-00655 2L

Primary Productivity of the Bot River Estuary, South Africa,
W89-00656 2L

Effect of Salinity and Temperature Variations on the Bacterial Population in the Bot River Estuary,
W89-00657 2L

Annual Cycle of Free-Floating Bacteria in the Bot River Estuary,
W89-00658 2L

Zooplankton and Some Environmental Conditions in the Bot River Estuary,
W89-00659 2L

Benthic Macrofauna of the Bot River Estuary, South Africa, with a Note on Its Meiofauna,
W89-00660 2L

Variations in the Use of the Bot River Estuary by Water-Birds,
W89-00661 2L

Ecological Role of the Red-Knobbed Coot, Fulica cristata Gmelin, at the Bot River Estuary, South Africa: A Preliminary Investigation,
W89-00662 2L

Comparison of the Physiological Condition of the Southern Mullet Liza richardsoni (Smith), in a Closed Estuary and the Sea,
W89-00663 2L

Mass Mortality of Fish Associated with Low Salinity Conditions in the Bot River Estuary,
W89-00664 2L

Changes in the Fish Fauna of the Bot River Estuary in Relation to Opening and Closure of the Estuary Mouth,
W89-00665 2L

Spatial Variability of Short-Term Rainfall Amounts in a Coastal Mountain Region of Southern Africa,
W89-00932 2B

Sewage Purification in South Africa - Past and Present,
W89-00933 5D

Determination of Water Use Efficiency of Veld in the Central Orange Free State from Evapotranspiration Measurements (Bepaling van Waterverbruiksdoeltreffendheid van Veld in die Sentrale Oranje-Vrystaat Vanaf Evapotranspirasiemetings),
W89-00934 2D

National Water Management in the Republic of South Africa: Towards a Consultative Partnership with Diverse Users in a Semi-Arid Country,
W89-01029 6D

SOUTHERN OSCILLATION

El Nino-Southern Oscillation and Rainfall Variability,
W89-00276 2B

SOVIET UNION

Control of the Conditions for Input of Hydropower Into the Unified Power System of the U.S.S.R.,
W89-00034 8C

Use of Horizontal Drainage for Draining Dam Slopes,
W89-00040 8C

New Life for Small Hydroelectric Stations in Kirgizia,
W89-00042 8C

Automation of Conveyor Transport at the Construction Site of Earth Dams,
W89-01173 8H

SPAIN

Heavy Metal Pollution in the Guadiamar River and the Guadalquivir Estuary (South West Spain),
W89-00573 5B

Epidemiological Study of the Legionella pneumophila Presence in Potable Water in Alicante,
W89-00925 5A

SPARGANIUM

High Rates of Production and Mortality of Submerged Sparganium emersum Rehman during Its Short Growth Season in a Eutrophic Danish Stream,
W89-00099 2H

SPARTINA
Contribution of Spartina alterniflora to the Pedra de Guaratiba (RJ) Salt Marsh Sediment Using Carbon-13 as a Tracer (Contribuicao de Materia Organica de Spartina alterniflora Para o Sedimento do Alagado de Pedra de Guaratiba (RJ): Uso de C13 como Tracador),
W89-00010 2L

Relationship between Nitrogen-Fixing Sulfate Reducers and Fermenters in Salt Marsh Sediments and Roots of Spartina alterniflora,
W89-00732 2L

Peat Accumulation and the Success of Marsh Plants,
W89-00909 2H

SPATIAL DISTRIBUTION
Climatography of Thunder Events in the Conterminous United States: Part II: Spatial Aspects,
W89-00275 2B

Diurnal Changes of pH Distribution and the Cascading of Shore Water in a Sargassum Forest,
W89-00682 2L

Spatial Variability of Short-Term Rainfall Amounts in a Coastal Mountain Region of Southern Africa,
W89-00932 2B

SPATIAL DISTRIBUTIONS
Examination of the Connection Between the Patchiness of Benthic Nutrient Efflux and Epiphytobenthos Patchiness on Intertidal Flats,
W89-00161 2L

SPAWNING
Prediction of Rainbow Trout Embryo Survival in Relation to Groundwater Seepage and Particle Size of Spawning Substrates,
W89-00326 2H

Effects of Temperature and Streamflow on Time and Duration of Spawning by Smallmouth Bass,
W89-00373 2H

Effects of Organic Contaminants on Reproduction of the Starry Flounder Platichthys stellatus in San Francisco Bay. I. Hepatic Contamination and Mixed-Function Oxidase (MFO) Activity During the Reproductive Season,
W89-00385 5C

Migratory Salmonids of the Estuary and Firth of Clyde,
W89-00828 5G

SPECIES COMPOSITION
Seasonal and Short-Term Fluctuations in the Zooplankton Community of Paranoa Reservoir, Brasilia, Federal District, Brazil (Flutuacoes Sazonais e de Curta Duracao na Comunidade Zooplanktonica do Lago Paranoa, Brasilia-DF, Brasil),
W89-00006 2H

Effect of a Heated Wastewater Discharge upon River Protozoan Species Pool Variability through Time and Space,
W89-00077 5C

Seasonal Composition, Biomass and Primary Productivity of the Phytoplankton in Lakitelek Backwater during 1980 and 1983,
W89-00144 2H

Seasonal Changes of Phytoplankton in the Backwater Bokros,
W89-00147 2H

Recurrence of Daphnia rosea in Lake Tahoe: Analysis of a Population Pulse,
W89-00216 2H

Zooplankton Community Grazing in a Hypertrophic Lake (Hartbeespoort Dam, South Africa),
W89-00220 2H

Rotifers of Warri River, Nigeria,
W89-00222 2H

Short-Term Variations in the Zooplankton Community Related to Water Exchange Processes in the Gullmar Fjord, Sweden,
W89-00228 2H

Habitat Requirements and Bioindicator Value of the Main Communities of Aquatic Vegetation in North-East Poland,
W89-00235 2H

Algal Studies of the River Ely, South Wales, U.K.: I. Phytoplankton,
W89-00678 2H

Exploited Fish and Shellfish Species in the Moray Firth,
W89-00779 2L

Intertidal Macrofauna of Nigg Bay,
W89-00780 2L

Epilithic Diatoms of the Clyde Estuary,
W89-00808 2L

Status of Fish Populations in the Clyde Estuary,
W89-00809 2L

Patterns of Association Between Birds and Invertebrates in the Clyde Estuary,
W89-00811 2L

Benthic Fauna of Sandy Bays, with Particular Reference to Irvine Bay,
W89-00819 5C

Benthos of the Deeper Sediments of the Firth of Clyde, with Particular Reference to Organic Enrichment,
W89-00820 5C

Saltmarshes of the Firth of Clyde,
W89-00830 2L

Fish, Fleas and Phytoplankton,
W89-00851 5C

Community Structure of Zooplankton in Eastern Hudson Bay,
W89-01232 2L

SPECIES DIVERSITY
Richness of Aquatic Macrophyte Floras of Soft Water Lakes of Differing pH and Trace Metal Content in Ontario, Canada,
W89-00103 5C

Faunas of Land-Locked Lagoons: Chance Differences and the Problems of Dispersal,
W89-00141 2L

Species Diversity of Algal Flora in Vishwamitri River, Baroda (India),
W89-00234 2H

Does pH Affect Fish Species Richness when Lake Area is Considered,
W89-00324 2H

Distribution of Chitinolytic Bacteria in Various Aquatic Systems: A Comparative Study,
W89-00402 2H

SPECTRAL ANALYSIS
Maximum Entropy Spectral Analysis of Hydrologic Data,
W89-01248 2A

SPECTROFLUOROMETRY
High Resolution Emission Spectroscopy (Shpol'skii Effect): A New Analytical Technique for the Analysis of Polycyclic Aromatic Hydrocarbons (PAH) in the Environmental Samples,
W89-00574 5A

SPECTROPHOTOMETRY
Chromium Trace Determination in Inorganic, Organic and Aqueous Samples with Isotope Dilution Mass Spectrometry (Chromspurenbestimmungen in Anorganischen, Organischen und wa-Brigen Proben mit der Massenspektrometrischen Isotopenverdunnungsanalyse),
W89-00268 5A

Selected Dyes for Residence Time Distribution Evaluation in Bioreactors,
W89-00404 5D

Determination of Traces of Bismuth in Water with Polyurethane Foam Thin-Layer Spectrophotometry,
W89-00482 5A

Precipitation and Indirect Spectrophotometric Determination of Sulfate Traces in Fresh Water with Lead Nitrate and Tetraphenylporphine Trisulfonic Acid,
W89-01085 5A

SPECTROSCOPY
Chromium Trace Determination in Inorganic, Organic and Aqueous Samples with Isotope Dilution Mass Spectrometry (Chromspurenbestimmungen in Anorganischen, Organischen und wa-Brigen Proben mit der Massenspektrometrischen Isotopenverdunnungsanalyse),
W89-00268 5A

High Resolution Emission Spectroscopy (Shpol'skii Effect): A New Analytical Technique for the Analysis of Polycyclic Aromatic Hydrocarbons (PAH) in the Environmental Samples,
W89-00574 5A

SPILLWAY FAILURE
Scour Channel Development after Spillway Failure,
W89-00897 2J

SPILLWAY GATES
Developing Release Schedules for a Gated Spillway,
W89-01006 8A

SPILLWAYS
Improvement of the Effectiveness of Spillway Operation of High-Head Hydroelectric Stations,
W89-00067 8B

Experience in Operating Hydraulic Structures and Equipment of Hydroelectric Stations,
W89-00554 8C

Developing Release Schedules for a Gated Spillway,
W89-01006 8A

SPIRULINA
Animal Wastes Media for Spirulina Production,
W89-00136 5D

SPOIL BANKS
Laboratory Study of the Accumulation and Toxicity of Contaminants at the Sea Surface from Sediments Proposed for Dredging,
W89-00858 5E

SPOIL DISPOSAL
Flocculent Settling above Zone Settling Interface,
W89-00484 5E

SPONTANEOUS POTENTIAL
General Correction for Spontaneous Potential Well Logs in Fresh Water,
W89-01195 7B

SPRING WATER
Chemistry and Delta 13C of Total Dissolved Carbon in Waters of Selected Springs Nearby Lublin City: Weekly Observations from October 1982 to June 1983,
W89-00895 2F

SPRINGS
Diel and Seasonal Carbon Budgets in Two Cold Spring Ecosystems,
W89-00177 2H

SQUALLS
Mesoscale Spiral Vortex Embedded within a Lake Michigan Snow Squall Band: High Resolution Satellite Observations and Numerical Model Simulations,
W89-00748 2B

SQUAWFISH
Leaching of Retorted Oil Shale: Assessing the Toxicity to Colorado Squawfish, Fathead Minnows, and Two Food-Chain Organisms,
W89-00329 5C

ST. LAWRENCE RIVER
Satellite Observations of Tidal Upwelling and Mixing in the St. Lawrence Estuary,
W89-00834 2L

ST. LUCIA
Twinning: Utility Pairing,
W89-00424 5F

STABILIZATION PONDS
Ammonia Nitrogen Removal in Attached-Growth Ponds,
W89-00489 5D

STABLE ISOTOPES
Chemistry and Delta 13C of Total Dissolved Carbon in Waters of Selected Springs Nearby Lublin City: Weekly Observations from October 1982 to June 1983,
W89-00895 2F

STANDING CROPS
Diel and Seasonal Carbon Budgets in Two Cold Spring Ecosystems,
W89-00177 2H

STATE JURISDICTION
Marsh Management Plans in Practice: Do They Work in Coastal Louisiana, USA,
W89-01060 2L

STATISTICAL ANALYSIS
Regionalization of Daily Rainfall in Kenya by Means of Common Factor Analysis,
W89-00473 2B

Annual Flow Statistics for Ungaged Streams in Idaho,
W89-00753 7C

Rain Measurement by Raingage-Radar Combination: A Geostatistical Approach,
W89-00761 7B

Data Analysis of Water Quality Time Series in Lake Erie,
W89-00866 7C

Nonparametric Tests for Trend Detection in Water Quality Time Series,
W89-00867 7C

Trends in Lead Concentrations in Major U.S. Rivers and Their Relation to Historical Changes in Gasoline-Lead Consumption,
W89-00868 5B

Tropical Eutrophic Lake Modeling and Parameter Discrimination,
W89-00872 2H

Estimation of Catchment Rainfall Uncertainty and its Influence on Runoff Prediction,
W89-00892 2A

Stream Nitrate Levels in a Small Catchment in South West England Over a Period of 15 Years (1970 - 1985),
W89-00915 5B

Assessment of Flood Frequency Models Using Empirical Distribution Function Statistics,
W89-00976 2E

Statistical Correlations for Predicting the Partition Coefficient for Nonpolar Organic Contaminants Between Aquifer Organic Carbon and Water,
W89-00992 5B

Quality Control Approach to NPDES Compliance Determination,
W89-01136 5D

Derivation of Baseflow Recession Constant Using Computer and Numerical Analysis,
W89-01142 2E

Approximate Confidence Intervals for Verification Criteria of the WMO Intercomparison of Snowmelt Runoff Models,
W89-01143 2E

Acidic Deposition Distribution and Episode Statistics from the MAP3S Network Database,
W89-01151 5B

Identification of a Multiple Input, Single Output, Linear, Time Invariant Model for Hydrological Forecasting,
W89-01209 7C

STATISTICAL METHODS
Texas Drought History Reconstructed and Analyzed from 1698 to 1980,
W89-00273 2B

Geostatistics Applied to Groundwater Pollution: III. Global Estimates,
W89-00493 5B

Annual Flow Statistics for Ungaged Streams in Idaho,
W89-00753 7C

Statistical Methods and Sampling Design for Estimating Step Trends in Surface-Water Quality,
W89-00862 7A

Parametric and Nonparametric Tests for Dependent Data,
W89-00864 7C

Tau-Like Test for Trend in the Presence of Multiple Censoring Points,
W89-00865 7C

Generalized Method of Moments Applied to LP3 Distribution,
W89-00901 2E

Ultrasonic Flowmeter for Testing Units of Large Hydroelectric and Pumped-Storage Stations,
W89-01181 8C

STATISTICAL MODELS
Dynamic Modeling of Primary Sedimentation,
W89-00483 5D

STATISTICS
Statistical Considerations Associated with the Use of the Heterotrophic Activity Method for Estimating V sub max and K' for Aquatic Environments,
W89-00280 7C

Application of Probability Weighted Moments in Estimating the Parameters of the Pearson Type Three Distribution,
W89-01198 7C

Determination of Probability Weighted Moments with the Incorporation of Extraordinary Values into Sample Data and Their Application to Estimating Parameters for the Pearson Type Three Distribution,
W89-01199 7C

Extreme-Value Theory Model for Dependent Observations,
W89-01208 7C

STEAM DISPLACEMENT
Nonaqueous Phase Liquid Transport and Cleanup: II. Experimental Studies,
W89-00969 5B

STELLENBOSCH
Rain Acidity in Stellenbosch,
W89-00454 5A

STILLING BASINS
Extreme Pressures in Hydraulic-Jump Stilling Basins,
W89-00896 8B

STOCHASTIC HYDROLOGY
River Basin Water Quality Management in Stochastic Environment,
W89-00490 5G

Distributed Parameter Approach for Evaluating the Accuracy of Groundwater Model Predictions: 1. Theory,
W89-00711 2F

Distributed Parameter Approach for Evaluating the Accuracy of Groundwater Model Predictions: 2. Application to Groundwater Flow,
W89-00712 2F

Stochastic Forecast of Water Losses,
W89-00759 7B

Value of Stochastic Streamflow Models in Overyear Reservoir Design Applications,
W89-01244 2E

Maximum Entropy Spectral Analysis of Hydrologic Data,
W89-01248 2A

STOCHASTIC MODELS
Distributed Parameter Approach for Evaluating the Accuracy of Groundwater Model Predictions: 1. Theory,
W89-00711 2F

Distributed Parameter Approach for Evaluating the Accuracy of Groundwater Model Predictions: 2. Application to Groundwater Flow,
W89-00712 2F

Evaluation of a Homogeneous Point Process Description of Arizona Thunderstorm Rainfall,
W89-00724 2B

STOCHASTIC PROCESS
Water Management for Lowland Rice Irrigation,
W89-00750 3F

Stochastic Forecast of Water Losses,
W89-00759 7B

Gradient Dynamic Programming for Stochastic Optimal Control of Multidimensional Water Resources Systems,
W89-00979 6A

STOKES SURFACES
Stokes Surfaces and the Effects of Near-Surface Groundwater-Table on Aeolian Deposition,
W89-00410 2J

STORAGE CAPACITY
Analysis and Assessment of Water Quantities in Lakes of China, (In Chinese),
W89-00531 2H

STORM DURATION
Climatography of Thunder Events in the Conterminous United States: Part I: Temporal Aspects,
W89-00274 2B

STORM FREQUENCY
Climatography of Thunder Events in the Conterminous United States: Part II: Spatial Aspects,
W89-00275 2B

STORM RUNOFF
Solute Sources and Transport in an Ephemeral Badland Catchment, Southeastern Alberta, Canada,
W89-00046 2J

Pipe Flow in James Bay Coastal Wetlands,
W89-00047 2A

Effect of Sediment Depth and Sediment Type on the Survival of Vallisneria americana Michx Grown from Tubers,
W89-00114 2H

Multicriterion Stormwater Management Methods,
W89-00302 4A

Effectiveness of an Urban Runoff Detention Pond-Wetlands System,
W89-00487 5G

Chemical-Hydrologic Interactions in the Near-Stream Zone,
W89-00717 2E

Alternative Strategies for Stormwater Detention,
W89-00875 4A

Quantity of Stormwater Runoff from Ten Stretches of Road, a Car Park and Eight Roofs in Hertfordshire, England During 1983,
W89-00912 4C

STORM SEEPAGE
Water Flow in Layered Soils with Sloping Surface,
W89-00752 2G

STORM SEWERS
Role of Economic Benefits Analysis in Funding Marine Combined Sewer Overflow Projects - Case Study of Boston Harbor,
W89-01132 6C

STORM SURGES
Numerical Simulation on Typhoon Surge and Surge Estimation of Huanghe River Estuary Region in Bohai Sea, (in Chinese),
W89-00543 2L

Water Movement and the Simulation of Storm Surges in the Firth of Clyde,
W89-00803 2L

STORMS
Role of Storms in the Summer Succession of the Phytoplankton Community in a Shallow Lake (Lake Balaton, Hungary),
W89-00232 2H

Numerical Simulation on Typhoon Surge and Surge Estimation of Huanghe River Estuary Region in Bohai Sea, (in Chinese),
W89-00543 2L

Evaluation of a Homogeneous Point Process Description of Arizona Thunderstorm Rainfall,
W89-00724 2B

STRATIFICATION
Shear Instability in a Highly Stratified Estuary,
W89-00415 2L

Diurnal Changes of pH Distribution and the Cascading of Shore Water in a Sargassum Forest,
W89-00682 2L

Studies on Formations and Changes of Micro-Stratification in Blackish Water Lake Shinji, (in Japanese),
W89-00772 2H

Intercomparison of Four Mixed Layer Models in a Shallow Inland Sea,
W89-00831 2H

STRATIFIED AQUIFERS
Theoretical Analysis of Deviations from Local Equilibrium During Sorbing Solute Transport Through Idealized Stratified Aquifers,
W89-00987 5B

STRATIGRAPHY
Geomorphology, Offshore Bathymetry and Quaternary Lithostratigraphy around the Bot River Estuary,
W89-00649 2L

STREAM BIOAT
Fish Production in the Kanawha River and its Relation To Barge Traffic,
W89-00249 6G

STREAM BIOTA
Biomass Production and Nutrient Cycling in Aquatic Macrophyte Communities of the Chowan River, North Carolina,
W89-00097 2H

High Rates of Production and Mortality of Submerged Sparganium emersum Rehman during Its Short Growth Season in a Eutrophic Danish Stream,
W89-00099 2H

Scanning Electron Microscopy of Bacteria and Diatoms Attached to a Submerged Macrophyte in an Increasingly Polluted Stream,
W89-00132 5C

Species Diversity of Algal Flora in Vishwamitri River, Baroda (India),
W89-00234 2H

Effect of Witobelskie and Lodzko-Dymaczewskie Lakes on Phytoplankton of Samica Steszewska River,
W89-00247 2H

Impacts of Navigation on Riverine Fish Production in the United States,
W89-00248 6G

Ecological and Saprobiological Status of the Rhine (Der Oekologisch-Saprobiologische Zustand des Rheins),
W89-00498 2H

STREAM DISCHARGE
Effect of Logging and Regeneration on Groundwater, Streamflow and Stream Salinity in the Southern Forest of Western Australia,
W89-00350 4C

STREAM EROSION
Sediment Transport of the Godavari River Basin and Its Controlling Factors,
W89-01211 2J

STREAM FISHERIES
Preservation of Natural Fish Reproduction during Hydrotechnical Construction on Rivers,
W89-00069 8I

STREAM GAGING
Drainage Basin Peak Discharge Rating Curve,
W89-00913 2E

Status of Isotope Hydrology Today,
W89-01018 2A

STREAM MODIFICATION
Regulated Rivers in the United Kingdom,
W89-00948 4A

River Regulation in the United Kingdom: An Historical Perspective,
W89-00949 4A

STREAM POLLUTION
Trends in Lead Concentrations in Major U.S. Rivers and Their Relation to Historical Changes in Gasoline-Lead Consumption,
W89-00868 5B

Stream Nitrate Levels in a Small Catchment in South West England Over a Period of 15 Years (1970 - 1985),
W89-00915 5B

STREAMBEDS
Comparison of Instream and Laboratory Methods of Measuring Sediment Oxygen Demand,
W89-00869 7B

STREAMFLOW
Experiences With the Assessment of the Residual Water Flow in Regulated Water Courses in the Salzburg Region (Erfahrungen bei der Beurteilung der Restwasserfuhrung von Ausleitungsstrecken im Land Salzburg),
W89-00164 4A

Susceptibility of Young-of-the-Year Fishes to Downstream Displacement by Flooding,
W89-00295 2H

Effects of Temperature and Streamflow on Time and Duration of Spawning by Smallmouth Bass,
W89-00373 2H

Estimation of the Time Scale of the Geomorphologic Instantaneous Unit Hydrograph from Effective Streamflow Velocity,
W89-00704 2E

Annual Flow Statistics for Ungaged Streams in Idaho,
W89-00753 7C

Landscape and Rainfall Indices for Prediction of Streamflow Similarities in the Hunter Valley, Australia,
W89-00972 2E

Hydrological Heterogeneity Catchment Morphology and Catchment Response,
W89-01024 2A

Sediment Transport of the Godavari River Basin and Its Controlling Factors,
W89-01211 2J

Value of Stochastic Streamflow Models in Overyear Reservoir Design Applications,
W89-01244 2E

STREAMFLOW REGULATION
Streamflow Regulation and Fish Community Structure,
W89-01053 4A

STREAMS
Spatial and Temporal Variability of the Index of Biotic Integrity in Three Midwestern Streams,
W89-00026 2E

Influence of Temperature on Microhabitat Choice by Fishes in a California Stream,
W89-00027 2H

Benthic Cyanophyte Associations in Streams and Lakes (Benthische Cyanophyten-Gemeinschaften in Bachen und Seen),
W89-00184 2H

Nutrient and Light Limitation of Algae in Two Northern California Streams,
W89-00296 2H

Relations Between Habitat Variables and Channel Catfish Populations in Prairie Streams,
W89-00325 2H

Effects of Stream Cleaning on Juvenile Coho Salmon and Dolly Varden in Southeast Alaska,
W89-00374 2H

Effects of Season and Substrate on Availability of Drift for Fish in a Small Warmwater Stream,
W89-00400 2H

Stream Chemistry in the New Jersey Pinelands: The Influence of Precipitation and Watershed Disturbance,
W89-00716 5B

Chemical-Hydrologic Interactions in the Near-Stream Zone,
W89-00717 2E

Predicting Regional Episodic Acidification of Surface Waters Using Empirical Models,
W89-00719 5B

Utility of Laboratory Streams for Ecosystem Toxicity Studies,
W89-01059 5B

Studies on Epilithic and Epiphytic Diatoms in a Chalkstream: Comparative Estimates of Chlorophyll a and Its Derivatives,
W89-01186 2H

Chemical Evolution of a Travertine-Depositing Stream: Geochemical Processes and Mass Transfer Reactions,
W89-01250 2K

STRESS ANALYSIS

Seismic Stress State of Underground Structures with Consideration of the Effect of the Free Surface,
W89-00035 8E

Components of Forces of a Reservoir Acting on the Foundation of High Dams,
W89-00073 8B

Certain Characteristics of Calculating Angular Retaining Walls,
W89-00076 8A

STRIPED BASS

Corneal Damage in Larvae of Striped Bass Morone saxatilis Exposed to Copper,
W89-00380 5C

STRUCTURAL ENGINEERING

Use of Clay Soils in the Construction of Cutoff Curtains,
W89-00549 8D

Experience in Determining the Numerical Characteristics of Landslide Movements,
W89-00551 8A

Improvement of the Layouts and Design of Underground Hydraulic Structures,
W89-01172 8E

Evaluation of the Reliability of Wave-Protection Slab Revetments of Embankment Slopes,
W89-01176 8D

STRUCTURAL GEOLOGY

Improvement of the Layouts and Design of Underground Hydraulic Structures,
W89-01172 8E

STRUCTURE-ACTIVITY RELATIONSHIPS

Predictive Structure-Toxicity Model with Daphnia magna,
W89-00591 5C

SUBLETHAL EFFECTS

Growth and Conversion Efficiency of the Catfish Heteropneustes fossilis (Bloch) Exposed to Sub-Lethal Concentrations of Sodium Pentachlorophenate,
W89-00243 5C

Impact of Manganese Intoxication on the Blood Pyruvic Acid of a Freshwater Tropical Perch Colisa fasciatus,
W89-00263 5A

Corneal Damage in Larvae of Striped Bass Morone saxatilis Exposed to Copper,
W89-00380 5C

Toxicity of Sea-Surface Microlayer: Effects On Herring and Turbot Embryos,
W89-00855 5C

Toxicity of Sea-Surface Microlayer: Effects of Hexane Extract on Baltic Herring (Clupea harengus) and Atlantic Cod (Gadus morhua) Embryos,
W89-00856 5C

Evaluation and Comparison of Two Short-Term Fathead Minnow Tests for Estimating Chronic Toxicity,
W89-01224 5A

SUBMERGED PLANTS

Effects of Fish Nests on Pattern and Zonation of Submersed Macrophytes in a Softwater Lake,
W89-00092 2H

Biomass and Nutritive Potential of Vallisneria americana Michx in Navigation Pool 9 of the Upper Mississippi River,
W89-00093 2H

Photosynthesis of Submersed Macrophytes in Acidified Lakes: II. Carbon Limitation and Utilization of Benthic CO2 Sources,
W89-00095 5C

High Rates of Production and Mortality of Submerged Sparganium emersum Rehman during Its Short Growth Season in a Eutrophic Danish Stream,
W89-00099 2H

Lake Enrichment by Submersed Macrophytes: A Norwegian Whole-Lake Experience with Elodea canadensis,
W89-00131 2H

Scanning Electron Microscopy of Bacteria and Diatoms Attached to a Submerged Macrophyte in an Increasingly Polluted Stream,
W89-00132 5C

Effects on the Benthic Fauna of Embanking an Intertidal Flat Area (The Markiezaat, Eastern Scheldt Estuary, The Netherlands),
W89-00676 6G

SUBSTRATES

National Field Evaluation of a Defined Substrate Method for the Simultaneous Enumeration of Total Coliforms and Escherichia coli from Drinking Water: Comparison with the Standard Multiple Tube Fermentation Method,
W89-00337 5A

Effects of Season and Substrate on Availability of Drift for Fish in a Small Warmwater Stream,
W89-00400 2H

SUBSURFACE DRAINAGE

Storm Response of the Karstic Carbonate Aquifer of Southcentral Kentucky,
W89-00349 2A

Subsurface Drainage Peak Flows in Shallow Soil,
W89-00749 4A

Use of Hydrogeochemical Sampling Data in Hydraulic Engineering,
W89-01178 2F

SUBTROPIC ZONE

Thermal Ecology of Surinsar, a Subtropical Freshwater Lake in Jammu, India,
W89-00242 2H

Sedimentary Environments and Facies of the Subtropical Mgeni Estuary, Southeast Africa,
W89-01084 2L

SUCCESSION

Historical Records of the Bot River Estuarine System,
W89-00653 2L

Determination of Water Use Efficiency of Veld in the Central Orange Free State from Evapotranspiration Measurements (Bepaling van Waterverbruiksdoeltreffendheid van Veld in die Sentrale Oranje-Vrystaat Vanaf Evapotranspirasiemetings),
W89-00934 2D

SULFATES

Role of External Ammonium Inputs in Freshwater Acidification,
W89-00024 5B

Soil Processes and Sulfate Loss at the Hubbard Brook Experimental Forest,
W89-00206 5B

Cycling of Inorganic and Organic Sulfur in Peat from Big Run Bog, West Virginia,
W89-00208 2H

Short-Term Trends in Sulfate Deposition at Selected Bulk Precipitation Stations in New York,
W89-00432 5B

Comparisons of RADM and Oscar Precipitation Chemistry Data,
W89-00433 5B

Effect of Sulfate and Organic Matter on The Hydrogen Sulfide Formation in Biofilms of Filled Sanitary Sewers,
W89-00510 5D

Role of Chemical Weathering in the Neutralization of Acidic Deposition,
W89-00696 5B

Relationship between Nitrogen-Fixing Sulfate Reducers and Fermenters in Salt Marsh Sediments and Roots of Spartina alterniflora,
W89-00732 2L

Interactions Between Groundwater Seepage and Sediment Porewater Sulphate Concentration Profiles in Lake Anna, Virginia,
W89-00910 5B

Patterns of Sulfate Reduction and the Sulfur Cycle in a South Carolina Salt Marsh,
W89-01046 2K

Surface Reactions of Synthetic, End-member Analogues of Monazite, Xenotime and Rhabdophane, and Evolution of Natural Waters,
W89-01080 2K

Precipitation and Indirect Spectrophotometric Determination of Sulfate Traces in Fresh Water with Lead Nitrate and Tetraphenylporphine Trisulfonic Acid,
W89-01085 5A

Hydrogeology of Two Saskatchewan Tills. II. Occurrence of Sulfate and Implications for Soil Salinity,
W89-01202 2F

SULFIDE
Kinetics of Sulfide Oxidation by Dissolved Oxygen,
W89-01130 5D

SULFIDES
Apparatus for Assessing Sulfide Generation Rates from Sewer Slimes,
W89-00497 5D

Effect of Sulphide on the Anaerobic Degradation of Propionate,
W89-00625 5D

SULFITES
Evaluation of the Sulfur(IV) Catalyzed Autoxidation of Cobalt(II) in an Azide Containing Medium as a Means for the Determination of Sulfite in Precipitation,
W89-00736 5A

SULFONATES
Toxicity of an Anionic Detergent to the Spawn and Larvae of Anurans (Amphibia),
W89-00139 5C

SULFUR
Chemistry of Atmospheric Precipitation in the Babia Gora National Park,
W89-00082 5B

Evaluation of the Sulfur(IV) Catalyzed Autoxidation of Cobalt(II) in an Azide Containing Medium as a Means for the Determination of Sulfite in Precipitation,
W89-00736 5A

Accumulation of Polycyclic Aromatic Hydrocarbons in Acid Sensitive Lakes,
W89-01074 5B

Relative Roles of Emissions Changes and Meteorological Variability of Wet sulfur Deposition: A Trajectory Model Study,
W89-01259 5B

SULFUR BACTERIA
Hypolimnetic Chlorophyll Maximum by Algae and Sulphur Bacteria in one Eutrophic Pond,
W89-00012 2H

SULFUR COMPOUNDS
Determination of Hydrophilic Thiols in Sediment Porewater Using Ion-Pair Liquid Chromatography Coupled to Electrochemical Detection,
W89-00266 7B

Investigations of Chlorinated Thiophenes: A Group of Bioaccumulable Compounds Identified in the Effluents from Kraft Bleaching,
W89-00360 5B

Effects of Sulphur Deposition on Lake-Water Chemistry in Ontario, Canada,
W89-00846 5B

SULFUR CYCLE
New Aspects of the Sulfur Cycle, with Special Reference to Shallow Waters,
W89-00183 5B

Cycling of Inorganic and Organic Sulfur in Peat from Big Run Bog, West Virginia,
W89-00208 2H

Patterns of Sulfate Reduction and the Sulfur Cycle in a South Carolina Salt Marsh,
W89-01046 2K

SULFUR DIOXIDE
Changes in Rainwater Acidity Associated with Closure of a Copper Smelter,
W89-00272 5B

Winter Cloud Water and Air Composition in Central Ontario,
W89-01265 5C

SULFUR SPRINGS
Diatoms and Other Algae from the Thermal-Sulphur Springs of Triponzo (Central Italy),
W89-00190 2H

SUPERCOOLING
Winter Diurnal Trends of Sierra Nevada Supercooled Liquid Water and Precipitation,
W89-00089 3B

Characteristic Features of Supercooled Raindrops in the Mid-Winter Season of Arctic Canada,
W89-00418 2B

SURFACE-GROUNDWATER RELATIONS
Esker Aquifers,
W89-00264 4B

Runoff Generation in a Plough-drained Peat Bog in Southern Scotland,
W89-00345 4C

Storm Response of the Karstic Carbonate Aquifer of Southcentral Kentucky,
W89-00349 2A

Chemical-Hydrologic Interactions in the Near-Stream Zone,
W89-00717 2E

Dry Stream Reaches in Carbonate Terranes: Surface Indicators of Ground-Water Reservoirs,
W89-00870 7B

Acidification of Shallow Groundwaters During the Spring Melt Period,
W89-00893 5B

Management of a Tributary Aquifer,
W89-00978 4B

Stability of Sand Slopes in the Groundwater Discharge Zones,
W89-01174 8D

SURFACE RUNOFF
Development of Streamlined Bog Islands in the Continental Interior of North America,
W89-00434 2H

Evaluation of Vegetation Filter Strips as a Best Management Practice for Feed Lots,
W89-01125 5G

SURFACE WATER
Predicting Regional Episodic Acidification of Surface Waters Using Empirical Models,
W89-00719 5B

SURGE TANKS
Reconstruction of the Surge Tank of the Sengilei Hydroelectric Station,
W89-00546 8C

SURVIVAL
Effects of Grazers and Light Penetration on the Survival of Transplants of Vallisneria americana Michx in the Tidal Potomac River, Maryland,
W89-00108 2H

SUSIDENCE
Cities Supported by Sticks in the Mud: A Variation on the Settlement of Land and Structures Caused by Ground Water Removal,
W89-01190 6E

SUSPENDED LOAD
Calculation of the Suspended Load in Rivers and Canals,
W89-00552 7B

SUSPENDED SEDIMENTS
Suspended Matter and Bottom Deposits in the Mahury Estuarine System (French Guiana): Environmental Consequences,
W89-00003 2J

Determinations of Suspended Sediment Concentrations from Multiple Day Landsat and AVHRR Data,
W89-00064 7B

Landsat-MSS Radiance as a Measure of Suspended Sediment in the Lower Yellow River (Hwang Ho),
W89-00065 7B

Particulate Concentrations in Lake St. Clair as Recorded by a Shipborne Multispectral Optical Monitoring System,
W89-00066 7B

Outwelling from Tropical Tidal Salt Flats,
W89-00140 2L

Nutrient Dynamics in Cumberland Basin - Chignecto Bay, A Turbid Macrotidal Estuary in the Bay of Fundy, Canada,
W89-00152 2L

Suspension of Large Concentrations of Sands,
W89-00900 2J

SUSPENDED SOLIDS
Physiological Effects on Coho Salmon and Steelhead of Exposure to Suspended Solids,
W89-00292 5C

Flocculation and De-Flocculation of Suspended Matter in Estuaries,
W89-00671 2L

New Measure of Interdependence Among Several Pollutants,
W89-01131 5D

In-Situ Method for Monitoring Layered Hydraulic Impedance Development During Artificial Recharge with Turbid Water,
W89-01205 2F

SUSPENSION
Suspension of Large Concentrations of Sands,
W89-00900 2J

SUWANNEE RIVER
Copper Binding by Dissolved Organic Matter: I. Suwannee River Fulvic Acid Equilibria,
W89-01077 5B

Copper Binding by Dissolved Organic Matter: II. Variation in Type and Source of Organic Matter,
W89-01078 5B

SWAMPS
Effects of a Cyperus papyrus L. Swamp on Domestic Waste Water,
W89-00107 5D

Microbiological Examination of the Carska Bara Swamp Water,
W89-00146 2H

SWEDEN
Evaluation of Lake Restoration in Sweden,
W89-00021 5G

Delayed Nutrient Responses to the Liming of Lake Gardsjon, Sweden,
W89-00441 5G

SWIETOKRZYSKIE LAKE
Changes in Chlorophyll Contents of Swietokrzyskie Lake Phytoplankton, as Related to Qualitative and Quantitative Fluctuations of Phytoplankton Density and of the Physicochemical Conditions in this Lake in Summer 1979,
W89-00257 5C

Qualitative and Quantitative Changes in Phytoplankton on the Background of Physicochemical

Changes in the Water of Swietokrzyskie Lake in the Years 1977-1979,
W89-00258 5C

SWIMMING
Feeding and Swimming Behavior in Grazing Microzooplankton,
W89-00382 2H

Association Between Seawater Pollution as Measured by Bacterial Indicators and Morbidity Among Bathers at Mediterranean Bathing Beaches of Israel,
W89-00579 5C

SWITZERLAND
Seasonal Productivity Cycle of Phytoplankton and Controlling Factors in Lake Constance,
W89-00022 2H

Origin and Size of Hypolimnic Mixing in Urnersee, the Southern Basin of Vierwaldstattersee (Lake Lucerne),
W89-00023 2H

Drift of Zooplankton in a Lake-Outlet (Glatt) in a Day-Night-Rhythm Depending from the Water Level,
W89-00025 2H

Quantum Yield as a Fundamental Parameter Controlling Vertical Photosynthetic Profiles of Phytoplankton in Lake Constance,
W89-00176 2H

Periphyton Diatom Communities and Trophic States of Three Shallow Lakes in the Pfynwald Region of Canton Valais, Switzerland,
W89-00195 2H

Contamination of Surface Sediments of the Principal Rivers of Geneva Canton by Polychlorinated Biphenyls and DDT (Contamination des Sediments Superficiels des Principales Rivieres du Canton de Geneve par les Polychlorobiphenyles et DDT),
W89-00690 5B

Interpretation of Metal Profiles in a Sediment Core from Lake Geneva: Metal Mobility or Pollution,
W89-00694 5B

Eutrophication and Benthic Fauna of Three Mountain Lakes (Eutrophisation et Faune Benthique de Trois Lacs de Montagne),
W89-00695 5C

SYSTEMS ANALYSIS
Systems Approach to Nitrate Removal from Groundwater Supplies,
W89-00134 5F

Use of Network Analysis Techniques in the Development and Optimization of a large UK Urban Water Distribution System (L'Emploi de Techniques),
W89-00918 5F

SZCZYTNO MALE LAKE
Chemical Characteristics of Bottom Sediment Top Layer in Szczytno Male Lake,
W89-00237 2H

Nitrogen and Phosphorus Balance in Lake Szczytno Male,
W89-00240 2H

Hydrochemical Study of Lake Szczytno Male With Trout Cage Culture,
W89-00241 5B

Sorption Properties of Bottom Sediments of Szczytno Male and Letowo Lakes,
W89-00256 2H

TAMAR ESTUARY
Nitrite and Ammonia in the Tamar Estuary,
W89-00154 5B

Comparison of Nutrients in the Interstitial Water of Reducing (Tamar Estuary) and Oxic (Carmarthen Bay) Coastal Sediments,
W89-00156 2L

TASMANIA
Interannual Variability in Climate and Fisheries in Tasmania,
W89-00847 2A

TECHNOLOGY
Technology, Institutions, and Social Goals,
W89-00871 6D

TECHNOLOGY TRANSFER
AWWA Small Systems Program,
W89-01114 5F

Rural Community Assistance Program,
W89-01115 5F

TEDDINGTON FLOW PROPOSAL
Regulation of the River Thames: A Case Study on the Teddington Flow Proposal,
W89-00955 4A

TEMPERATE ZONE
Relationship between Zooplankton Development and Environmental Conditions in Different Types of Lakes in the Zone of Temperate Climate.
W89-00138 2H

Spatial Patterns of N Fixation (Acetylene Reduction) along Environmental Gradients in a Warm-Temperate Estuary,
W89-00475 2L

TEMPERATURE
Patterns of Temperature and Humidity in Wetland Biotopes,
W89-00124 2H

TEMPERATURE EFFECTS
Influence of Temperature on Microhabitat Choice by Fishes in a California Stream,
W89-00027 2H

Effect of a Heated Wastewater Discharge upon River Protozoan Species Pool Variability through Time and Space,
W89-00077 5C

Study of the Temperature Dependence of the Acute Toxicity of Pentachlorophenol to a Freshwater Pond Snail, Viviparus bengalensis L.,
W89-00078 5C

Equations Relating Growth and Uptake of Nitrogen by Salvinia molesta to Temperature and the Availability of Nitrogen,
W89-00111 2H

Thermal Ecology of Surinsar, a Subtropical Freshwater Lake in Jammu, India,
W89-00242 2H

Adaptation of Phytoplankton-Degrading Microbial Communities to Thermal Reactor Effluent in a New Cooling Reservoir,
W89-00336 5C

Dynamics of Dissolved Silicium and Nitrogen-Nutrients at Low Temperature in the EMS-Dollard Estuary,
W89-00673 2L

Algal Studies of the River Ely, South Wales, U.K.: I. Phytoplankton,
W89-00678 2H

Groundwater Flow Systems in Mountainous Terrain: 1. Numerical Modeling Technique,
W89-00708 2F

Groundwater Flow Systems in Mountainous Terrain: 2. Controlling Factors,
W89-00709 2F

Long-Term Changes in Some Benthic Species in the Firth of Clyde, with Particular Reference to Tellina tenuis da Costa,
W89-00817 5C

Effects of Light and Temperature on Photosynthesis of the Nuisance Alga Cladophora glomerata (L.) Kutz from Green Bay, Lake Michigan,
W89-00848 2H

Kinetics of Sulfide Oxidation by Dissolved Oxygen,
W89-01130 5D

TEMPORAL DISTRIBUTION
Climatography of Thunder Events in the Conterminous United States: Part I: Temporal Aspects,
W89-00274 2B

Estimation of the Time Scale of the Geomorphologic Instantaneous Unit Hydrograph from Effective Streamflow Velocity,
W89-00704 2E

TENNESSEE
Annual Elemental Input/Output Estimates for Two Forested Watersheds in Eastern Tennessee,
W89-01168 5B

TERRAIN ANALYSIS
Dry Stream Reaches in Carbonate Terranes: Surface Indicators of Ground-Water Reservoirs,
W89-00870 7B

TERRELL
Historical Use of Ground Water in Terrell, Texas,
W89-00461 4B

TEXAS
Texas Drought History Reconstructed and Analyzed from 1698 to 1980,
W89-00273 2B

TEXTILE MILL WASTES
Cotton Yarn and Fabric Finishing Wastewater Treatment in Upflow Anaerobic Filter,
W89-00277 5D

Treatability Studies of Textile Wastewater,
W89-00627 5D

Application of Biologically Activated Sorptive Columns for Textile Waste Water Treatment,
W89-00632 5D

THAILAND
Improving Water Supply in Thailand,
W89-00422 5F

THAMES CATCHMENT
Environmentally Sound River Engineering Examples from the Thames Catchment,
W89-00962 4A

THAMES RIVER
Regulation of the River Thames: A Case Study on the Teddington Flow Proposal,
W89-00955 4A

THE NETHERLANDS
Phytoplankton Composition of Stagnant and Tidal Ecosystems in Relation to Salinity, Nutrients, Light and Turbulence,
W89-00001 2L

River Ems: Processes Affecting the Behaviour of Metals and Organochlorines during Estuarine Mixing,
W89-00149 5B

Monitoring of Mercury Pollution in Dutch Coastal Waters by Means of the Teleostean Fish Zoarces Viviparus,
W89-00150 5C

THE NETHERLANDS

Evaluation of Seasonal Nutrient Dynamics in the Oosterschelde (SW Netherlands),
W89-00153 2L

Experimental Determination of Salt Intrusion Mechanisms in the Volkerak Estuary,
W89-00667 2L

THERMAL POLLUTION
Application of Ecological Modelling: Impact of Thermal Effluent on a Smallmouth Bass Population,
W89-00317 5C

Macroinvertebrate Populations in a Thermally Impacted Reservoir,
W89-00397 5C

Long-Term Changes in Some Benthic Species in the Firth of Clyde, with Particular Reference to Tellina tenuis da Costa,
W89-00817 5C

THERMAL RADIATION
Estimation of Bare Soil Evaporation from Airborne Measurements,
W89-00352 7B

THERMAL SPRINGS
Diatoms and Other Algae from the Thermal-Sulphur Springs of Triponzo (Central Italy),
W89-00190 2H

THERMAL STRATIFICATION
Mixing of Temperature-Stratified Lakes and Reservoirs by Buoyant Jets,
W89-00492 5G

Seasonal Phytoplankton Demographic Processes and Experiments on Interspecific Competition,
W89-00906 2H

Thermal Simulation of a Lake with Winter Ice Cover,
W89-01044 2H

THERMAL STRESS
Adaptation of Phytoplankton-Degrading Microbial Communities to Thermal Reactor Effluent in a New Cooling Reservoir,
W89-00336 5C

THERMODYNAMICS
Thermal Simulation of a Lake with Winter Ice Cover,
W89-01044 2H

Cogeneration Power Desalination Plants,
W89-01064 3A

THIOBENCARB
Comparison of Laboratory and Field Observations of Fish Exposed to the Herbicides Molinate and Thiobencarb,
W89-00376 5C

THIOCYANATE
Acute Toxicity of Thiocyanate to Trout,
W89-00330 5C

THIOLS
Determination of Hydrophilic Thiols in Sediment Porewater Using Ion-Pair Liquid Chromatography Coupled to Electrochemical Detection,
W89-00266 7B

THIOPHENES
Investigations of Chlorinated Thiophenes: A Group of Bioaccumulable Compounds Identified in the Effluents from Kraft Bleaching,
W89-00360 5B

THIRAM
Determination of Thiram in Water and Soils by Cathodic Stripping Voltammetry Based on Adsorptive Accumulation,
W89-01087 5A

THIRD WORLD
O and M Spending Levels in Third World Irrigation Systems: Exploring Economic Alternatives,
W89-00874 3F

THUNDER
Climatography of Thunder Events in the Conterminous United States: Part I: Temporal Aspects,
W89-00274 2B

Climatography of Thunder Events in the Conterminous United States: Part II: Spatial Aspects,
W89-00275 2B

THUNDERSTORMS
Evaluation of a Homogeneous Point Process Description of Arizona Thunderstorm Rainfall,
W89-00724 2B

THYMIDINE
Estimating Bacterial Production in Marine Waters from the Simultaneous Incorporation of Thymidine and Leucine,
W89-00729 7B

TIDAL BASINS
Residual Fluxes of Water in an Estuarine Lagoon,
W89-00142 2L

TIDAL CREEKS
Exchange of Phosphorus between a Euhaline Vegetated Marsh and the Adjacent Tidal Creek,
W89-00283 5B

TIDAL CURRENTS
Water Quality in the Inverness and Beauly Firths,
W89-00789 5B

TIDAL EFFECTS
Tidal Transport of Planktonic Copepods across the Sill of a British Columbia Fjord,
W89-00221 2L

Tidal Asymmetry and Estuarine Morphology,
W89-00670 2L

Clyde Sea Hydrography,
W89-00802 2L

Water Movement and the Simulation of Storm Surges in the Firth of Clyde,
W89-00803 2L

Hydrography of Irvine Bay and Its Relation to the Clyde Sea Area,
W89-00805 2L

Satellite Observations of Tidal Upwelling and Mixing in the St. Lawrence Estuary,
W89-00834 2L

TIDAL FLATS
Outwelling from Tropical Tidal Salt Flats,
W89-00140 2L

Heat Balance of a Tidal Flat Area,
W89-00148 2L

Dredging Activities in the Dutch Wadden Sea: Effects on Macrobenthic Infauna,
W89-00151 2L

Role of Sewage Effluent in the Accumulation of Macroalgal Mats on Intertidal Mudflats in Two Basins in Southern England,
W89-00159 5C

Examination of the Connection Between the Patchiness of Benthic Nutrient Efflux and Epiphytobenthos Patchiness on Intertidal Flats,
W89-00161 2L

Effects on the Benthic Fauna of Embanking an Intertidal Flat Area (The Markiezaat, Eastern Scheldt Estuary, The Netherlands),
W89-00676 6G

TIDAL MARSHES
Factors Influencing Aboveground Production of Scirpus Marshes in the St. Lawrence Estuary, Quebec, Canada,
W89-00529 2L

Dispersal and Recruitment of Fiddler Crab Larvae in the Delaware River Estuary,
W89-01039 2L

TIDAL POWERPLANTS
Tidal Power Ruffles Feathers,
W89-00850 8A

TIDAL RIVERS
Effects of Grazers and Light Penetration on the Survival of Transplants of Vallisneria americana Michx in the Tidal Potomac River, Maryland,
W89-00108 2H

Effect of Sediment Depth and Sediment Type on the Survival of Vallisneria americana Michx Grown from Tubers,
W89-00114 2H

TIDES
Residual Fluxes of Water in an Estuarine Lagoon,
W89-00142 2L

TILAPIA
Biochemical Changes in the Liver of Fish, Tilapia mossambica (Peters), during Continuous Exposure to Monocrotophos,
W89-00085 5C

TILLAGE
Intrapedal Macropore Distribution and Infiltration Rate of Three Friona Polypedons,
W89-00408 2G

TIME DOMAIN REFLECTOMETRY
Multiple Reflection and Attenuation of Time Domain Reflectometry Pulses: Theoretical Considerations of Applications to Soil and Water,
W89-00701 7B

TIME SERIES ANALYSIS
Multivariate Nonparametric Tests for Trend in Water Quality,
W89-00863 7C

Data Analysis of Water Quality Time Series in Lake Erie,
W89-00866 7C

Nonparametric Tests for Trend Detection in Water Quality Time Series,
W89-00867 7C

Multivariate Periodic ARMA (1,1) Processes,
W89-00967 7B

Extreme-Value Theory Model for Dependent Observations,
W89-01208 7C

TIN
Determination of Organotins in Natural Waters by Toluene Extraction and Graphite Furnace AAS,
W89-00743 5A

TINTINNIDS
Tintinnids and Other Microzooplankton - Seasonal Distributions and Relationships to Resources and Hydrography in a Maine Estuary,
W89-00223 2L

TISSUE ANALYSIS
Methods for Determination of Sum Parameters and Characterization of Organochlorine Com-

pounds in Spent Bleach Liquors from Pulp Mills and Water, Sediment and Biological Samples from Receiving Waters,
W89-00358 5A

Micronucleus Test: Examples of Application to Marine Ecology,
W89-01042 5A

TISZA RIVER
Water Quality of the Tisza River and the Alpar Backwater,
W89-00143 5B

Seasonal Composition, Biomass and Primary Productivity of the Phytoplankton in Lakitelek Backwater during 1980 and 1983,
W89-00144 2H

Tisza Water, as Irrigation Water, Polluted with Various Compounds,
W89-00145 3C

Seasonal Changes of Phytoplankton in the Backwater Bokros,
W89-00147 2H

TOLERANCE
PCB-resistant Diatoms in the Hudson River Estuary,
W89-00284 5C

TOPOGRAPHY
Landscape and Rainfall Indices for Prediction of Streamflow Similarities in the Hunter Valley, Australia,
W89-00972 2E

TORTS
Toxic and Environmental Torts within Admiralty,
W89-00518 6E

TOXIC WASTE TREATMENT
Removal of Organic Toxic Pollutants by Trickling Filter and Activated Sludge,
W89-01133 5D

TOXIC WASTES
Load Allocation for Toxics Using Monte Carlo Techniques,
W89-00514 5G

TOXICITY
Study of the Temperature Dependence of the Acute Toxicity of Pentachlorophenol to a Freshwater Pond Snail, Viviparus bengalensis L.,
W89-00078 5C

Biochemical Changes in the Liver of Fish, Tilapia mossambica (Peters), during Continuous Exposure to Monocrotophos,
W89-00085 5C

Toxicity Bioassay of Technical and Commercial Formulations of Carbaryl to the Freshwater Catfish, Clarias batrachus,
W89-00086 5C

Heavy-Metal Toxicity in the Cyanobacterium Nostoc linckia,
W89-00094 5C

Toxicity of an Anionic Detergent to the Spawn and Larvae of Anurans (Amphibia),
W89-00139 5C

Tisza Water, as Irrigation Water, Polluted with Various Compounds,
W89-00145 3C

Model Ecosystems as a Tool in Freshwater and Marine Research,
W89-00180 5B

Limits of Growth of Five Chlorella Species in the Presence of Toxic Heavy Metals,
W89-00191 5C

Bromothymol-Blue Test: A Simple Algal Bioassay and its Use for Herbicide Screening,
W89-00192 5A

Acute Toxicity of Ammonia to Common Carp (Cyprinus carpio L.),
W89-00244 5C

Impact of Manganese Intoxication on the Blood Pyruvic Acid of a Freshwater Tropical Perch Colisa fasciatus,
W89-00263 5A

Waste Transformer Oil and PCB Toxicity to Rainbow Trout,
W89-00328 5C

Leaching of Retorted Oil Shale: Assessing the Toxicity to Colorado Squawfish, Fathead Minnows, and Two Food-Chain Organisms,
W89-00329 5C

Acute Toxicity of Thiocyanate to Trout,
W89-00330 5C

Physiological Disturbances in Fish Exposed to Bleached Kraft Mill Effluents,
W89-00363 5C

Sublethal Effects of Chlorinated Phenols and Resin Acids on Rainbow Trout (Salmo gairdneri),
W89-00364 5C

Effects of Pulp Mill Effluents on Skeletal Parameters in Fish: A Progress Report,
W89-00365 5C

Effects of Pulp Mill Effluent on a Baltic Coastal Fish Community,
W89-00366 5C

Effects of a Bleached Pulp Mill Effluent on Growth and Gonad Function in Baltic Coastal Fish,
W89-00367 5C

Organochlorine Compounds in the Environment,
W89-00368 5C

Mutagenicity in Pulp and Paper Mill Effluents and in Recipient,
W89-00370 5C

Influence of pH and Ammonia Salts on Ammonia Toxicity and Water Balance in Young Channel Catfish,
W89-00377 5C

Acute Toxicities of Eleven Metals to Early Life-History Stages of the Yellow Crab Cancer anthonyi,
W89-00386 5C

Depressed Mercury Levels in Biota from Acid and Metal Stressed Lakes Near Sudbury, Ontario,
W89-00442 5B

Toxic and Environmental Torts within Admiralty,
W89-00518 6E

Effects of Six Heavy Metals on Hatching Eggs and Survival of Larva of Marine Fish, (in Chinese),
W89-00533 5C

Transient Liver Pathology in Patients Consuming Water from a Private Well Contaminated by PCBs from a Submersible Water Pump,
W89-00558 5C

Method to Assess Periodic Responses of Aquatic Microecosystems to Photosynthetic Inhibition,
W89-00562 7B

Influence of Chemicals upon Plankton in Freshwater Systems,
W89-00581 5C

Predictive Structure-Toxicity Model with Daphnia magna,
W89-00591 5C

Effects of Lindane and Atropine Sulphate on the Tissues of the Fish, Anabas testudineus (Bloch): A Chronotoxicological Approach,
W89-00594 5C

Photo-induced Toxicity of Polycyclic Aromatic Hydrocarbons to Larvae of the Fathead Minnow (Pimephales promelas),
W89-00595 5C

Assessment of the Toxicity of Heavy Metals to the Anaerobic Digestion of Sewage Sludge,
W89-00631 5D

Sea-Surface Microlayer of Puget Sound: Part I: Toxic Effects on Fish Eggs and Larvae,
W89-00853 5C

Sea-Surface Microlayer of Puget Sound: Part II: Concentrations of Contaminants and Relation to Toxicity,
W89-00854 5C

Toxicity of Sea-Surface Microlayer: Effects On Herring and Turbot Embryos,
W89-00855 5C

Toxicity of Sea-Surface Microlayer: Effects of Hexane Extract on Baltic Herring (Clupea harengus) and Atlantic Cod (Gadus morhua) Embryos,
W89-00856 5C

Laboratory Study of the Accumulation and Toxicity of Contaminants at the Sea Surface from Sediments Proposed for Dredging,
W89-00858 5E

Hepatic Lesions in English Sole (Parophrys vetulus) from Commencement Bay, Washington (USA),
W89-00859 5C

Induced Resistance to Polychlorinated Biphenyls Confers Cross-Resistance and Altered Environmental Fitness in a Marine Diatom,
W89-00860 5C

Use of Factorial Experimental Design to Evaluate How Biotic and Abiotic Factors Influence Cadmium Accumulation in the Unicellular Alga Dunaliella bioculata,
W89-01043 5B

Acute and Chronic Toxicity of Triphenyltin Hydroxide to Fathead Minnows (Pimephales promelas) Following Brief or Continuous Exposure,
W89-01057 5C

Utility of Laboratory Streams for Ecosystem Toxicity Studies,
W89-01059 5B

Copper Binding by Dissolved Organic Matter: I. Suwannee River Fulvic Acid Equilibria,
W89-01077 5B

Copper Binding by Dissolved Organic Matter: II. Variation in Type and Source of Organic Matter,
W89-01078 5B

Reactivity of the Carbonate Radical with Aniline Derivatives,
W89-01088 5B

Effects of Acute Exposure to Acidified Water on the Behavorial Response of Fathead Min-

nows, Pimephales Promelas, to Alarm Substance (Schreckstoff),
W89-01092 5C

Estimating the Acute Toxicity of Waterborne Chemicals in Trout from Measurements of Median Lethal Dose and the Octanol-Water Partition Coefficient,
W89-01095 5C

Volume Fraction Correlation for Narcosis in Aquatic Organisms: The Key Role of Partitioning,
W89-01096 5C

Comparison of Three Sediment Bioassay Methods Using Detroit River Sediments,
W89-01097 5A

Comparative Sensitivities of Bluegill, Channel Catfish and Fathead Minnow to pH and Aluminum,
W89-01098 5C

Sensitivity of Freshwater Pulmonate Snails, Lymnaea luteola L., to Heavy Metals,
W89-01154 5C

Uptake and Distribution of Copper Sulphate and Its Effect on the Respiration Rate of the Hemocyanin-Producing Freshwater Snail Lymnaea natalensis,
W89-01155 5G

Branchial and Renal Pathology in the Fish Exposed Chronically to Methoxy Ethyl Mercuric Chloride,
W89-01156 5C

Toxicity of Alkyllead Salts to Anaerobic Nitrogen Transformations in Sediment,
W89-01167 5C

Evaluation and Comparison of Two Short-Term Fathead Minnow Tests for Estimating Chronic Toxicity,
W89-01224 5A

Assessment of Selenium Toxicity in Algae Using Turbidostat Culture,
W89-01230 5C

TRACE ELEMENTS

Trace Element Content in Drinking Water of Nasopharyngeal Carcinoma Patients,
W89-00048 5C

Concentrations of Trace Metals in the Qiantagnjiang River and its Estuary in Southern China,
W89-00443 5B

TRACE LEVELS

Indirect Trace Determination of Ethylenediaminetetraacetic Acid (EDTA) in Water by Potentiometric Stripping Analysis,
W89-00481 5A

Occurrence and Distribution of Trace Organic Compounds in Bermuda Precipitation,
W89-01148 5B

TRACE METALS

Continuous-flow System for the Determination of Cobalt in Sea and River Water: In-line Preconcentration/Separation Coupled with Catalytic Determination,
W89-00063 5A

Solubilities of Trace Copper and Lead Species and the Complexing Capacity of River Water in the Linggi River Basin,
W89-00084 5B

Richness of Aquatic Macrophyte Floras of Soft Water Lakes of Differing pH and Trace Metal Content in Ontario, Canada,
W89-00103 5C

Catalytic Determination of Copper in Natural Water at Microgram/L Level by Flow Injection Analysis, (in Chinese),
W89-00201 7B

Chemical Behavior of Metal Elements in the Sediments in the Hanjiang River Estuary and Shantou Port, (in Chinese),
W89-00202 2L

Isotope Ratio Measurements of Mo, V, Ti, and Zr and the Determination of These Elements in Water Samples with a Thermal Ionization Quadrupole Mass Spectrometer (Isotopenverhaltnismessung von Mo, V, Ti and Zr Sowie Deren Konzentrationsbestimmung in Wassern Mit Einem Thermionen-Quadrupol-Massenspektrometer),
W89-00267 5A

Soil Solution in a Soil Treated with Digested Sewage Sludge,
W89-00413 5B

Determination of Traces of Bismuth in Water with Polyurethane Foam Thin-Layer Spectrophotometry,
W89-00482 5A

Application of the Principle of Least Sigma to the Chemical Model of Natural Water, (in Chinese),
W89-00537 2H

Determination of Trace Chromium in Natural Water by Polarographic Catalytic Wave Analysis, (in Chinese),
W89-00538 5A

Chromium Speciation in the Huanghe River and Its Estuarine Region, (in Chinese),
W89-00544 5B

Environmental Conditions in Abu Kir Bay, East of Alexandria: II. Plankton Distribution, Downstream from Land-Based Effluents,
W89-00578 5C

Contaminant Concentrations and Toxicity of Sea-Surface Microlayer Near Los Angeles, California,
W89-00857 5C

Variability of Dissolved Trace Metals in the Mississippi River,
W89-01075 5B

Trace Metal Geochemistry of Pore Water Brines from Two Hypersaline Lakes,
W89-01079 2K

Dissolution of Trace Metals from Particles of Industrial Origin and Its Influence on the Composition of Rainwater,
W89-01149 5B

TRACERS

Selected Dyes for Residence Time Distribution Evaluation in Bioreactors,
W89-00404 5D

Tracer Test Analysis of Anisotropy in Hydraulic Conductivity of Granular Aquifers,
W89-00940 2F

Tracing of Water Movement in the Unsaturated Zone Using Stable Isotopes of Hydrogen and Oxygen,
W89-01016 2G

Status of Isotope Hydrology Today,
W89-01018 2A

Use of Hydrogeochemical Sampling Data in Hydraulic Engineering,
W89-01178 2F

Stable Isotope Study of Recharge Processes in the English Chalk,
W89-01197 2F

Modeling of Tracer Spreading in a Fracture in which the Aperture Decreases with Depth in a Laminar Flow (Modelisation de la Propagation d'un Traceur dans une Fracture qui se Ferme Progressivement en Profondeur dans l'Hypothese d'un Ecoulement Laminaire Parallele),
W89-01214 2F

Transport Modelling of Biological Tracers from Septic Systems,
W89-01226 5B

TRAINING

Rural Community Assistance Program,
W89-01115 5F

TRANSMISSION LINES

Control of the Conditions for Input of Hydropower Into the Unified Power System of the U.S.S.R.,
W89-00034 8C

TRANSMISSION TOWERS

Control of the Conditions for Input of Hydropower Into the Unified Power System of the U.S.S.R.,
W89-00034 8C

TRANSPARENCY

Primary Production in the Orinoco River,
W89-00907 2H

Lake Response Modeling Using Biologically Available Phosphorus,
W89-01236 5C

TRANSPIRATION

Does Transpiration Limit the Growth of Vegetation or Vice Versa,
W89-01013 2I

TRAVERTINE

Chemical Evolution of a Travertine-Depositing Stream: Geochemical Processes and Mass Transfer Reactions,
W89-01250 2K

TREND ANALYSIS

Nonparametric Approaches to Environmental Impact Assessment,
W89-00861 7C

Statistical Methods and Sampling Design for Estimating Step Trends in Surface-Water Quality,
W89-00862 7A

Multivariate Nonparametric Tests for Trend in Water Quality,
W89-00863 7C

Tau-Like Test for Trend in the Presence of Multiple Censoring Points,
W89-00865 7C

Nonparametric Tests for Trend Detection in Water Quality Time Series,
W89-00867 7C

Trends in Lead Concentrations in Major U.S. Rivers and Their Relation to Historical Changes in Gasoline-Lead Consumption,
W89-00868 5B

TRENDS

Short-Term Trends in Sulfate Deposition at Selected Bulk Precipitation Stations in New York,
W89-00432 5B

TRIBUTARIES

Fractal Nature of River Networks,
W89-00975 2E

TRICHLOROPHENOL
Evaluation of Aquatic Environmental Fate of 2,4,6-Trichlorophenol with a Mathematical Model,
W89-00616 5B

TRICKLING FILTERS
Removal of Organic Toxic Pollutants by Trickling Filter and Activated Sludge,
W89-01133 5D

TRIHALOMETHANES
Trihalomethane Formation in High-Bromide Lake Galilee Water,
W89-00426 5F

TRIPHENYLTIN HYDROXIDE
Acute and Chronic Toxicity of Triphenyltin Hydroxide to Fathead Minnows (Pimephales promelas) Following Brief or Continuous Exposure,
W89-01057 5C

TRITIUM INJECTION
Validity of the Environmental Chloride Method for Recharge Evaluation of Coastal Aquifers, India.
W89-00356 7B

TRONDHEIMSFJORD
Effect of Light Regime upon Growth Rate and Chemical Composition of a Clone of Skeletonema costatum from the Trondheimsfjord, Norway,
W89-00212 2L

TROPHIC DYNAMICS
Body Size and Mass Flow in Freshwater Plankton: Models and Tests,
W89-00218 2H

TROPHIC LEVEL
Freshwater Mollusks as Indicators of Trophic Conditions in Coastal Lakes of Southern Brazil (Moluscos Dulceaquicolas Como Indicadores de Condicoes Troficas em Lagoas Costeiras do Sul do Brasil),
W89-00008 5A

Periphyton Diatom Communities and Trophic States of Three Shallow Lakes in the Pfynwald Region of Canton Valais, Switzerland,
W89-00195 2H

Body Size and Mass Flow in Freshwater Plankton: Models and Tests,
W89-00218 2H

Spatial and Temporal Distribution Patterns of Three Trophic Levels in a Saline Lake,
W89-00219 2H

TROPHIC LEVELS
Eutrophication and Benthic Fauna of Three Mountain Lakes (Eutrophisation et Faune Benthique de Trois Lacs de Montagne),
W89-00695 5C

TROPHIC STATE
Trophic State Gradients and Zooplankton and Zoobenthos Distribution in a Po River Delta Lagoon,
W89-00580 2L

TROPICAL REGIONS
Tropical Wetlands as a Carbon Source,
W89-00118 2H

Microbial-Meiofaunal Interrelationships in Some Tropical Intertidal Sediments,
W89-00766 2L

Vertical Distribution of Phytoplankton in a Stratified Lake (Lago Dom Helvecio, Southeastern Brazil) with Special Reference to the Metalimnion,
W89-00768 2H

TROUT
Primary Production in Lakes with Cage Trout Culture,
W89-00238 2H

Hydrochemical Study of Lake Szczytno Male With Trout Cage Culture,
W89-00241 5B

Chlorophyll Relationships in Letowo and Szczytno Male Lakes, with Trout Cage Culture,
W89-00262 2H

Effect of Low pH on Survival of Brook Trout Embryos and Yolk-Sac Larvae in West Virginia Streams,
W89-00293 5C

Prediction of Rainbow Trout Embryo Survival in Relation to Groundwater Seepage and Particle Size of Spawning Substrates,
W89-00326 2H

Waste Transformer Oil and PCB Toxicity to Rainbow Trout,
W89-00328 5C

Acute Toxicity of Thiocyanate to Trout,
W89-00330 5C

Sublethal Effects of Chlorinated Phenols and Resin Acids on Rainbow Trout (Salmo gairdneri),
W89-00364 5C

Estimating the Acute Toxicity of Waterborne Chemicals in Trout from Measurements of Median Lethal Dose and the Octanol-Water Partition Coefficient,
W89-01095 5C

TUMORS
Tumor Frequencies and Contaminant Concentrations in Brown Bullheads from an Industrialized River and a Recreational Lake,
W89-00028 5C

TUNDRA
Productivity and Nutrient Cycling of Alaskan Tundra: Enhancement by Flowing Soil Water,
W89-00908 2G

Runoff Generation in a Low Arctic Drainage Basin,
W89-01207 2A

TUNISIA
Temporal Variability in Spatial Correlation of Daily Rainfall,
W89-01247 2B

TUNNEL CONSTRUCTION
Gas Shows during Construction of Hydraulic Tunnels,
W89-00071 8E

Improvement of the Layouts and Design of Underground Hydraulic Structures,
W89-01172 8E

TUNNEL LININGS
Calculation of Pressure Tunnel Linings with Consideration of Consolidation Grouting of the Rocks,
W89-00547 8C

TUNNELING
Prospects of Improving the Prediction of the Hazard of Rock Bursts During Tunneling,
W89-00038 8E

TUNNELS
Calculation of Seismic Safety of Tunnels During Blasting,
W89-00037 8E

Outlet Structure Design for Conduits and Tunnels,
W89-00307 8A

Transient Pressures in Hydrotechnical Tunnels During Earthquakes,
W89-00448 8E

TURBIDITY
Effects of River Discharge and Vertical Circulation on Aquatic Primary Production in a Turbid Louisiana (USA) Estuary,
W89-00005 2L

Calculation of the Suspended Load in Rivers and Canals,
W89-00552 7B

In-Situ Method for Monitoring Layered Hydraulic Impedance Development During Artificial Recharge with Turbid Water,
W89-01205 2F

TURBIDITY CURRENTS
Basin Sedimentation and the Growth of Prograding Deltas,
W89-00832 2J

Records of Riverborne Turbidity Currents and Indications of Slope Failures in the Rhone Delta of Lake Geneva,
W89-01049 2J

TURBINES
Set of Documents for Overhauling RO400-960-11 Turbines of the Inguri Hydroelectric Station,
W89-00060 8C

Modification of Turbine Runner Blades at the Chirkey Hydroelectric Station,
W89-00555 8C

Simplified Turbine Runner Shows Good Cavitation Resistance,
W89-01003 8C

Water Supply Yields Power,
W89-01254 8C

TURBOT
Toxicity of Sea-Surface Microlayer: Effects On Herring and Turbot Embryos,
W89-00855 5C

TURBULENT FLOW
Analysis of Turbulent Buoyant Jet in Density-Stratified Water,
W89-00491 5B

TURKEY
Flow Regimes and Dynamic Equilibrium of Morphological Changes at Koycegiz Lake Inlet, Turkey,
W89-00449 8B

Two Toxicants, Mercury and Tin in the Gulf of Iskenderun,
W89-00570 5B

MODALP: A Deterministic Rainfall-Runoff Model for Large Karstic Areas,
W89-01145 2F

TURNOVER
Body Size and Mass Flow in Freshwater Plankton: Models and Tests,
W89-00218 2H

TWINNING
Twinning: Utility Pairing,
W89-00424 5F

TYPHA
Experimental Studies on the Resiliency of Floating Typha Mats in a Freshwater Marsh,
W89-00287 2H

UGANDA
Guinea Worm Disease in Northern Uganda: A Major Public Health Problem Controllable Through an Effective Water Programme,
W89-00278 5F

ULTRASONICS
Ultrasonic Flowmeter for Testing Units of Large Hydroelectric and Pumped-Storage Stations,
W89-01181 8C

UNCERTAINTY
Method for Locating Wells in a Groundwater Monitoring Network Under Conditions of Uncertainty,
W89-00971 7A

UNCONFINED AQUIFERS
Microscale Haline Convection - A Proposed Mechanism for Transport and Mixing at the Water Table Region,
W89-00718 2F

UNDERGROUND POWERPLANTS
China's Experience with Underground Works,
W89-01007 8H

UNDERGROUND STRUCTURES
Seismic Stress State of Underground Structures with Consideration of the Effect of the Free Surface,
W89-00035 8E

Prospects of Improving the Prediction of the Hazard of Rock Bursts During Tunneling,
W89-00038 8E

Earthquake Response of Submerged Circular Arch,
W89-00306 8A

Transient Pressures in Hydrotechnical Tunnels During Earthquakes,
W89-00448 8E

Improvement of the Layouts and Design of Underground Hydraulic Structures,
W89-01172 8E

UNGAGED STREAMS
Annual Flow Statistics for Ungaged Streams in Idaho,
W89-00753 7C

UNIT GRADIENT
Effect of Assumed Unit Gradient During Drainage on the Determination of Unsaturated Hydraulic Conductivity and Infiltration Parameters,
W89-00407 2G

UNIT HYDROGRAPHS
Regression Estimates for Topological-Hydrograph Input,
W89-00304 2E

Estimation of the Time Scale of the Geomorphologic Instantaneous Unit Hydrograph from Effective Streamflow Velocity,
W89-00704 2E

UNITED KINGDOM
Regulated Rivers in the United Kingdom,
W89-00948 4A

River Regulation in the United Kingdom: An Historical Perspective,
W89-00949 4A

River Regulation: A Regional Perspective - Northumbrian Water Authority,
W89-00950 4A

Outstanding Problems in River Regulation,
W89-00963 4A

UNITED NATIONS
Water Supply and Sanitation - Cornerstones of the World Health Organization's Forty Years of International Health Development,
W89-00917 5F

UNITED STATES
Impacts of Navigation on Riverine Fish Production in the United States,
W89-00248 6G

Climatography of Thunder Events in the Conterminous United States: Part I: Temporal Aspects,
W89-00274 2B

Climatography of Thunder Events in the Conterminous United States: Part II: Spatial Aspects,
W89-00275 2B

Occurrence of Radon, Radium, and Uranium in Groundwater,
W89-01108 5B

UNSATURATED FLOW
Hydrogeological and Hydrogeochemical studies of the Unsaturated Flow in a Gravel Aquifer: Part II. Results of Long Term Soil-hydrological Measurements (Hydrogeologische und Hydrochemische Untersuchungen in der Ungesaettigten Zone eines Kiesgrundwasserleiters: Teil II. Ergebnisse Langjaehriger Bodenhydrologischer Messungen),
W89-00503 2F

Steady Unsaturated Seepage above a Sloping Impermeable Base,
W89-00726 2G

Modelling Soil Water Dynamics in the Unsaturated Zone: State of the Art,
W89-01014 2G

Soil Physics and Hydrology,
W89-01026 2G

UPWELLING
Satellite Observations of Tidal Upwelling and Mixing in the St. Lawrence Estuary,
W89-00834 2L

URANIUM
Reliability of Chemical Analyses of Water Samples: The Experience of the UMTRA Project,
W89-00941 5A

Methods for Removing Uranium from Drinking Water,
W89-01110 5F

URANIUM RADIOISOTOPES
Operating a Small Full-Scale Ion Exchange System for Uranium Removal,
W89-01107 5F

Occurrence of Radon, Radium, and Uranium in Groundwater,
W89-01108 5B

URBAN AREAS
Networking Urban Water Supplies in West Africa,
W89-00419 5F

Analysis of Halogenated Polycyclic Aromatic Hydrocarbons in Urban Air, Snow and Automobile Exhaust,
W89-00613 5B

Sea-Surface Microlayer of Puget Sound: Part I: Toxic Effects on Fish Eggs and Larvae,
W89-00853 5C

Sea-Surface Microlayer of Puget Sound: Part II: Concentrations of Contaminants and Relation to Toxicity,
W89-00854 5C

URBAN HYDROLOGY
Quantity of Stormwater Runoff from Ten Stretches of Road, a Car Park and Eight Roofs in Hertfordshire, England During 1983,
W89-00912 4C

URBAN RUNOFF
Urban Runoff Simulation Model,
W89-00301 2E

Effectiveness of an Urban Runoff Detention Pond-Wetlands System,
W89-00487 5G

Contributions of Heavy Metals from Municipal Runoff to the Sediments of Lake Pontchartrain, Louisiana,
W89-00618 5B

Size Distribution and Copper Association of Dissolved Organic Material in Urban Runoff,
W89-00628 5B

Quantity of Stormwater Runoff from Ten Stretches of Road, a Car Park and Eight Roofs in Hertfordshire, England During 1983,
W89-00912 4C

Lake Response Modeling Using Biologically Available Phosphorus,
W89-01236 5C

URBANIZATION
Multicriterion Stormwater Management Methods,
W89-00302 4A

USSR
Ultrasonic Flowmeter for Testing Units of Large Hydroelectric and Pumped-Storage Stations,
W89-01181 8C

UTAH
Endangered Woundfin and Water Management in the Virgin River, Utah, Arizona, Nevada,
W89-00311 6G

UTILITIES
GAC Treatment Cost Experience at Two Drinking Water Utilities,
W89-00495 5F

VALVES
Valves for Controlling Pressure, Flow and Level,
W89-01102 5F

VANCOUVER
54 Hours of Continuous Post-Frontal Precipitation North of the Alpine Mountain Barrier, 22-25 August 1975,
W89-00464 2B

VARIABILITY
El Nino-Southern Oscillation and Rainfall Variability,
W89-00276 2B

VARIATION COEFFICIENT
Vertical Variability of Soil Properties in a Small Watershed,
W89-00354 2G

VEGETATION
Does Transpiration Limit the Growth of Vegetation or Vice Versa,
W89-01013 2I

VEGETATION ESTABLISHMENT
Ecohydrological Approach to Floral and Vegetational Patterns in Arctic Landscape Ecology,
W89-00435 2H

VEGETATION REGROWTH
Effects of Disturbances Along Hydroelectrical Transmission Corridors Through Peatlands in Northern Manitoba, Canada.
W89-00436 4C

VERTICAL
Vertical Variability of Soil Properties in a Small Watershed,
W89-00354 2G

VERTICAL DISTRIBUTION
Vertical Distribution of Phytoplankton in a Stratified Lake (Lago Dom Helvecio, Southeastern Brazil) with Special Reference to the Metalimnion,
W89-00768 2H

VERTICAL FLOW
Hydrogeology of Two Saskatchewan Tills. I. Fractures, Bulk Permeability, and Spatial Variability of Downward Flow,
W89-01201 2F

VINYL CORE MEDIA
Performance of Vinyl Core Media Trickling Filter Plant for Secondary Treatment of Municipal Wastewater,
W89-00502 5D

VIRGIN RIVER
Endangered Woundfin and Water Management in the Virgin River, Utah, Arizona, Nevada,
W89-00311 6G

VIRGINA
Interjurisdictional Management in Chesapeake Bay Fisheries,
W89-01073 6E

VIRUSES
Viral Pollution of Surface Waters by Domestic Waste Water Discharge (Die Viral-Verunreinigung der Oberflachengewasser durch Ableiten der Haushaltsabwasser),
W89-00170 5B

Wound Fiberglass Depth Filters as a Less Expensive Approach for the Concentration of Viruses from Water,
W89-00279 5A

Novel Approach for Modifying Microporous Filters for Virus Concentration from Water,
W89-00332 5A

Relationship between Numbers of Enteroviruses and Bacteriophages Infecting Bacteroides fragilis in Different Environmental Samples,
W89-00645 5A

Polyethylene Glycol Precipitation for Recovery of Pathogenic Viruses, Including Hepatitis A Virus and Human Rotavirus, from Oyster, Water, and Sediment Samples,
W89-00730 5A

Characterization of the Interaction Between Viruses and a Solid Polymeric Contact Disinfectant,
W89-00884 5F

Microbial Characterization of Municipal Wastewater at a Spray Irrigation Site: the Lubbock Infection Surveillance Study,
W89-01124 7B

Detection of Environmental Viruses in Sludge: Enhancement of Enterovirus Plaque Assay Titers with 5-Iodo-2'-Deoxyuridine and Comparison to Adenovirus and Coliphage Titers,
W89-01220 5A

Mechanism of Inactivation of Tobacco Mosaic Virus with Ozone,
W89-01229 5F

VISCOMETERS
Laboratory Analysis of Mudflow Properties,
W89-00899 2J

VISCOSITY
Laboratory Analysis of Mudflow Properties,
W89-00899 2J

VISCOSITY COEFFICIENT
Dynamical Structure of Vertically Two-Dimensional Estuary in Steady State,
W89-00680 2L

VISHWAMITRI RIVER
Species Diversity of Algal Flora in Vishwamitri River, Baroda (India),
W89-00234 2H

VISTULA RIVER
Indicatory Role of Some Invertebrates for Quality of Water in the Vistula River and in Subsequent Stages of Its Treatment,
W89-00236 5A

Influence of the Vistula River on Distribution of 226Ra in the Gdansk Bay,
W89-00250 2K

VOLATILE ORGANIC COMPOUNDS
Purge and Trap Analysis of Aqueous Samples with Cryofocusing,
W89-00446 5A

Motor-Boat-Derived Volatile Organic Compounds (VOC) in Lake water,
W89-00499 5B

VOLATILTIY
Field Measurements of Water-Air Exchange of Mercury in Freshwater Systems,
W89-00640 5A

VOLKERAK ESTUARY
Experimental Determination of Salt Intrusion Mechanisms in the Volkerak Estuary,
W89-00667 2L

VOLTAMMETRY
Determination of Heavy Metals at the Pg/g Level in Antarctic Snow with DPASV and IDMS,
W89-00270 5A

Determination of Cobalt Ions in Natural Waters Using Differential Pulse Adsorptive Stripping Voltammetry,
W89-00480 5A

WABIGOON RIVER
Field Measurements of Water-Air Exchange of Mercury in Freshwater Systems,
W89-00640 5A

WADDEN SEA
Dredging Activities in the Dutch Wadden Sea: Effects on Macrobenthic Infauna,
W89-00151 2L

WAHNBACH RESERVOIR
Chemical Methods of P-Elimination in the Tributaries of Reservoirs and Lakes,
W89-00020 5G

WALES
Regulating the River Severn,
W89-00954 4A

Impact of River Regulations on Invertebrate Communities in the U.K.,
W89-00959 4A

Aluminum Speciation in Surface Waters from a Welsh Upland Area,
W89-01055 5B

Stream Acidification Trends in the Welsh Uplands: A Modelling Study of the Llyn Brianne Catchments,
W89-01206 5C

WARRI RIVER
Rotifers of Warri River, Nigeria,
W89-00222 2H

WASHINGTON
Changes in Rainwater Acidity Associated with Closure of a Copper Smelter,
W89-00272 5B

WASP
General Water Supply System Simulation Model: WASP,
W89-00299 5F

WASTE ALLOCATION
Waste Allocation Simulation Models,
W89-01234 5D

WASTE DISPOSAL
Flocculent Settling above Zone Settling Interface,
W89-00484 5E

Effect of pH and Contact Time on the Concentration of As(III) and As(V) in Coal Ash Systems,
W89-00624 5E

Effluent Disposal and the Physical Environment,
W89-00804 5E

Use of the Clyde Estuary and Firth for the Disposal of Effluents,
W89-00824 5E

Effects of Three Organics on Selected Physical Properties of Type I Portland Cement,
W89-00994 5E

Estimation of the Risk Associated with the Organic Constituents of Hazardous and Municipal Waste Landfill Leachates,
W89-00995 5B

Design Criteria for In-Situ and On-Site Renovation of an Industrial Sludge Lagoon,
W89-00996 5B

Leaching of Inorganic Hazardous Constituents from Stabilized/Solidified Hazardous Wastes,
W89-00999 5E

Contaminant Hydrogeology Dollars and Sense,
W89-01028 5B

Disposal of Radium Removed from Drinking Water,
W89-01106 5E

WASTE RECOVERY
Copper, Nickel, and Chrome Recovery in a Jobshop to Eliminate Waste Treatment and Sludge Disposal,
W89-00993 5D

WASTE STABILIZATION
Effects of Three Organics on Selected Physical Properties of Type I Portland Cement,
W89-00994 5E

Leaching of Inorganic Hazardous Constituents from Stabilized/Solidified Hazardous Wastes,
W89-00999 5E

Transmission Electron Microscopic Study of Solidified/Stabilized Organics,
W89-01000 5E

WASTE TREATMENT
Compressible Cake Filtration: Monitoring Cake Formation and Shrinkage Using Synchrotron X-rays,
W89-00512 5D

Waste Allocation Simulation Models,
W89-01234 5D

WASTES
Animal Wastes Media for Spirulina Production,
W89-00136 5D

WASTEWATER
Preliminary Study on the Migration and Transformation of Heavy Metals in the Sewage-Seawater Mixing Zone of Jinzhou Bay, (in Chinese),
W89-00199 5B

Environmental Effects of Paper Industry Wastewaters: An Overview,
W89-00362 5C

Impact of a Municipal Wastewater Effluent on Water Quality, Periphyton, and Invertebrates in the Little Miami River Near Xenia, Ohio,
W89-00685 5C

Evaluation of Chemical Oxidizers for Hydrogen Sulfide Control,
W89-01129 5D

Studies on the Degradation of Synthetic Detergents by Sewage,
W89-01159 5B

WASTEWATER ANALYSIS
Methods for Determination of Sum Parameters and Characterization of Organochlorine Compounds in Spent Bleach Liquors from Pulp Mills and Water, Sediment and Biological Samples from Receiving Waters,
W89-00358 5A

High Molar Mass Lignin in Bleached Kraft Pulp Mill Effluents,
W89-00361 5A

Apparatus for Assessing Sulfide Generation Rates from Sewer Slimes,
W89-00497 5D

Application of Headspace Gas Chromatography to the Monitoring of Organic Substances in Industrial Effluent,
W89-00572 5A

WASTEWATER COMPOSITION
Viability Determination of Ascaris Eggs Recovered from Waste-Water,
W89-00644 5A

Isolation, Identification and Characterisation of Filamentous and Floc-Forming Bacteria from Activated Sludge Flocs,
W89-00648 5D

WASTEWATER DISPOSAL
Effects of a Cyperus papyrus L. Swamp on Domestic Waste Water,
W89-00107 5D

Load Allocation for Toxics Using Monte Carlo Techniques,
W89-00514 5G

Use of the Clyde Estuary and Firth for the Disposal of Effluents,
W89-00824 5E

Septic System Performance on a Coastal Barrier Island,
W89-01163 5D

Shallowly Placed, Low Pressure Distribution System to Treat Domestic Wastewater in Soils with Fluctuating High Water Tables,
W89-01171 5D

WASTEWATER FACILITIES
Movement of Sludge through Conveyor Centrifuge,
W89-00485 5D

Planning Indiana's Water Infrastructure from a Competitive Perspective,
W89-00880 6B

WASTEWATER LAGOONS
Review of Rock Filters for the Upgrade of Lagoon Effluents,
W89-01235 5D

WASTEWATER MANAGEMENT
Multicriterion Selection of Wastewater Management Alternatives,
W89-00300 5D

Funding Reserve Capacity in Wastewater Systems,
W89-00506 5D

Developer Financing of Public Wastewater Service Infrastructure,
W89-00507 5D

Cost Efficiency of Transferable Discharge Permit Markets for Control of Multiple Pollutants,
W89-00697 5G

WASTEWATER MANAGEMENT FACILITIES
Water/Wastewater Facilities Get Better with Electronics,
W89-00392 5D

WASTEWATER OUTFALL
Effects of Discontinuing Disinfection on a Receiving Water,
W89-00515 5D

Association Between Seawater Pollution as Measured by Bacterial Indicators and Morbidity Among Bathers at Mediterranean Bathing Beaches of Israel,
W89-00579 5C

WASTEWATER POLLUTION
Effects of Discharge Fluctuation and the Addition of Fine Sediment on Stream Fish and Macroinvertebrates Below a Water-Filtration Facility,
W89-01061 5C

WASTEWATER RENOVATION
Effects of a Cyperus papyrus L. Swamp on Domestic Waste Water,
W89-00107 5D

WASTEWATER TREATMENT
Multi-Component Sorption Isotherms of Basic Dyes onto Peat,
W89-00083 5D

Animal Wastes Media for Spirulina Production,
W89-00136 5D

Instrumentation for 7-Day Continuous Cycle Monitoring of Metals with Automated On-Line Sample Preparation, High-Performance Liquid Chromatography, and Electrochemical Detection,
W89-00210 5A

Testing the Secondary Treatment of Effluents from the 'Police' Chemical Plant in Carp Ponds,
W89-00255 5D

Simultaneous Removal of Heavy Metal Ions from Wastewater by Foam Separation Techniques,
W89-00265 5D

Cotton Yarn and Fabric Finishing Wastewater Treatment in Upflow Anaerobic Filter,
W89-00277 5D

Water/Wastewater Facilities Get Better with Electronics,
W89-00392 5D

Selected Dyes for Residence Time Distribution Evaluation in Bioreactors,
W89-00404 5D

Land Application of Domestic Wastewater, Wood Production, and Sludge Composting: An Economic and Energy Production Analysis,
W89-00465 5E

Simultaneous Gas Chromatographic Determination of Nitrobenzene and 2,4-Dinitrophenol in Nitrobenzene Manufacturing Plant Wastewater,
W89-00479 5A

Dynamic Modeling of Primary Sedimentation,
W89-00483 5D

Movement of Sludge through Conveyor Centrifuge,
W89-00485 5D

Ammonia Nitrogen Removal in Attached-Growth Ponds,
W89-00489 5D

Removal of Cadmium using Chitosan,
W89-00496 5D

Performance of Vinyl Core Media Trickling Filter Plant for Secondary Treatment of Municipal Wastewater,
W89-00502 5D

Funding Reserve Capacity in Wastewater Systems,
W89-00506 5D

Developer Financing of Public Wastewater Service Infrastructure,
W89-00507 5D

Innovative Septic System Management,
W89-00508 5D

Removal of Pentachlorophenol in Municipal Activated Sludge Systems,
W89-00509 5D

Influence of Feeding Procedure on Microbial Reductions and Performance of Anaerobic Digestion,
W89-00511 5D

Effect of Culture History on the Determination of Biodegradation Kinetics by Batch and Fed-Batch Techniques,
W89-00513 5D

Effects of Discontinuing Disinfection on a Receiving Water,
W89-00515 5D

Destruction of Polychlorinated Dibenzo-p-Dioxins and Dibenzofurans in Contaminated Water Samples Using Ozone,
W89-00606 5D

Treatment of Dye-Containing Effluents with Different Bentonites,
W89-00615 5D

Review of the Behaviour and Utilization of Polycarboxylic Acids as Detergent Builders,
W89-00620 5D

Micromixing and Dispersion in Chlorine Contact Chambers,
W89-00622 5D

Effect of Sulphide on the Anaerobic Degradation of Propionate,
W89-00625 5D

Effects of Biofilter Media on the Performance of Anaerobic Hybrid Reactors,
W89-00626 5D

Treatability Studies of Textile Wastewater,
W89-00627 5D

Removal of Chrome Dye from Carpet Effluents Using Coal: I,
W89-00630 5D

Application of Biologically Activated Sorptive Columns for Textile Waste Water Treatment,
W89-00632 5D

Adsorption of Indigo Carmine by Activated Carbon,
W89-00633 5D

High Level Disinfection of Wastewaters for Reuse,
W89-00642 5D

Liquid Effluents of the Fish Canning Industries of Rio de Janeiro State: Treatment Alternatives,
W89-00646 5D

Cost Efficiency of Transferable Discharge Permit Markets for Control of Multiple Pollutants,
W89-00697 5G

Operation of a Three-Phase Biofilm Fluidized Sand Bed Reactor for Aerobic Wastewater Treatment,
W89-00747 5D

Characterization of the Interaction Between Viruses and a Solid Polymeric Contact Disinfectant,
W89-00884 5F

Bulking Control with Ozonation in a Nutrient Removal Activated Sludge System,
W89-00930 5D

Sewage Purification in South Africa - Past and Present,
W89-00933 5D

Copper, Nickel, and Chrome Recovery in a Jobshop to Eliminate Waste Treatment and Sludge Disposal,
W89-00993 5D

Formation of Hydrous Zirconium (IV) Oxide Polyelectrolyte Membranes, I. Poly (itaconic acid) and Poly (acrylic-co-itaconic acid),
W89-01062 3A

Preliminary Plan for Membrane Desalination in China,
W89-01066 3A

Selecting a Contract Operator for Your Water or Wastewater Facility,
W89-01100 5F

Fine Bubble Aeration: Considerations in Design and Operation,
W89-01101 5D

Making the Right Moves in SCADA Selection,
W89-01103 5F

Disposal of Radium Removed from Drinking Water,
W89-01106 5E

Microbial Characterization of Municipal Wastewater at a Spray Irrigation Site: the Lubbock Infection Surveillance Study,
W89-01124 7B

Phosphorus Removal by Crystallization Using a Granular Activated Magnesia Clinker,
W89-01126 5D

In situ Adapation of Activated Sludge by Shock Loading to Enhance Treatment of High Ammonia Content Petrochemical Wastewater,
W89-01127 5D

Use of Duckweed for Wastewater Treatment,
W89-01128 5D

Kinetics of Sulfide Oxidation by Dissolved Oxygen,
W89-01130 5D

New Measure of Interdependence Among Several Pollutants,
W89-01131 5D

Removal of Organic Toxic Pollutants by Trickling Filter and Activated Sludge,
W89-01133 5D

Quality Control Approach to NPDES Compliance Determination,
W89-01136 5D

Sequential Wet Air Regeneration of PAC from the Powdered Carbon-Activated Sludge Process,
W89-01137 5D

Biosorption of Organic Halide in a Kraft Mill Generated Lagoon,
W89-01138 5D

MCRT for Control of Cokemaking Wastewater treatment,
W89-01139 5D

Studies on the Degradation of Synthetic Detergents by Sewage,
W89-01159 5B

Septic System Performance on a Coastal Barrier Island,
W89-01163 5D

Kinetics and Reaction Engineering of Anaerobic Sewage Treatment (Kinetik und Reaktionstechnik der anaeroben Abwasserreinigung),
W89-01185 5D

Effect of Environmental Conditions on the Occurrence of Microthrix parvicella in Activated Sludge,
W89-01217 5D

Determination of Microbial Kinetic Coefficients through Measurement of Initial Rates by Radiochemical Techniques,
W89-01218 5D

Effects of Cyanide and Polyphosphates on Adsorption of Metals from Simulated and Real Mixed-Metal Plating Wastes,
W89-01219 5D

Detection of Environmental Viruses in Sludge: Enhancement of Enterovirus Plaque Assay Titers with 5-Iodo-2'-Deoxyuridine and Comparison to Adenovirus and Coliphage Titers,
W89-01220 5A

Mechanism of Inactivation of Tobacco Mosaic Virus with Ozone,
W89-01229 5F

Water Pollution Control in Dallas-Fort Worth,
W89-01233 5G

Review of Rock Filters for the Upgrade of Lagoon Effluents,
W89-01235 5D

Anaerobic Treatment of Leachate Using Fixed Film and Sludge Bed Systems,
W89-01238 5D

Drafting Water Quality Agreements,
W89-01253 6E

Activated Sludge Systems with Biomass Particle Support Structures,
W89-01256 5D

WATER ANALYSIS

Determination of Organic Matter in River Sediments,
W89-00169 7B

Catalytic Determination of Copper in Natural Water at Microgram/L Level by Flow Injection Analysis, (in Chinese),
W89-00201 7B

Determination of Naphthenic Acids in California Crudes and Refinery Wastewaters by Fluoride Ion Chemical Ionization Mass Spectrometry,
W89-00209 5A

Instrumentation for 7-Day Continuous Cycle Monitoring of Metals with Automated On-Line Sample Preparation, High-Performance Liquid Chromatography, and Electrochemical Detection,
W89-00210 5A

Determination of Hydrophilic Thiols in Sediment Porewater Using Ion-Pair Liquid Chromatography Coupled to Electrochemical Detection,
W89-00266 7B

Isotope Ratio Measurements of Mo, V, Ti, and Zr and the Determination of These Elements in Water Samples with a Thermal Ionization Quadrupole Mass Spectrometer (Isotopenverhaltnismessung von Mo, V, Ti and Zr Sowie Deren Konzentrationsbestimmung in Wassern Mit Einem Thermionen-Quadrupol-Massenspektrometer),
W89-00267 5A

Analysis of ppb Levels of Organics in Water by Means of Purge-and-Trap, Capillary Gas Chromatography and Selective Detectors,
W89-00288 5A

Methods for Determination of Sum Parameters and Characterization of Organochlorine Compounds in Spent Bleach Liquors from Pulp Mills and Water, Sediment and Biological Samples from Receiving Waters,
W89-00358 5A

Comparisons of RADM and Oscar Precipitation Chemistry Data,
W89-00433 5B

Rapid Specific Environmental Coliform Monitoring,
W89-00445 5A

Purge and Trap Analysis of Aqueous Samples with Cryofocusing,
W89-00446 5A

Determination of Free Cyanide in Water by Released Fluorescence of a Dissociated Ternary Complex,
W89-00477 5A

Simultaneous Gas Chromatographic Determination of Nitrobenzene and 2,4-Dinitrophenol in Nitrobenzene Manufacturing Plant Wastewater,
W89-00479 5A

Determination of Cobalt Ions in Natural Waters Using Differential Pulse Adsorptive Stripping Voltammetry,
W89-00480 5A

Determination of Traces of Bismuth in Water with Polyurethane Foam Thin-Layer Spectrophotometry,
W89-00482 5A

Determination of Trace Chromium in Natural Water by Polarographic Catalytic Wave Analysis, (in Chinese),
W89-00538 5A

Extraction and Determination of Chlorophyll from Benthic Green Algae with Dimethyl Sulfoxide, (in Chinese),
W89-00539 7B

WATER ANALYSIS

Studies on Marine Humic Substances: III. The Distribution of Humic Substances in Seawater and Sediments in the Estuary of Changjiang River and East China Sea, (in Chinese),
W89-00541 2L

Preconcentration of Heavy Metals in Natural Waters with Hydrazones Supported on Silica Gel,
W89-00568 5A

Application of Headspace Gas Chromatography to the Monitoring of Organic Substances in Industrial Effluent,
W89-00572 5A

Determination of Phenoxy Acid Herbicides in Water Samples,
W89-00576 5A

Determination of Total Organic Chlorine and Bromine in Water Samples by Adsorption onto Activated Carbon and Neutron Activation Analysis,
W89-00588 5A

Determination of Polychlorinated Dibenzofurans in Surface Water by Means of Liquid Chromatography Using on-Line Sample Preconcentration and Different Spectroscopic Detection Techniques,
W89-00590 5A

Effects of Aquatic Humic Substances on Analysis for Hydrogen Peroxide Using Peroxidase-Catalyzed Oxidations of Triarylmethanes or p-Hydroxyphenylacetic Acid,
W89-00634 7B

Sediment-Water Core Sampler for Coastal Pollution Studies,
W89-00641 5A

Determination of Fluoride Ion in Well Waters of Eastwood School District, Wood County, Ohio,
W89-00684 5A

Phosphorus Determination in Rivers (Phosphor in Fliessgewaessern und Seine Analytische Bestimmung),
W89-00735 5A

Negative Thermal Ionization Mass Spectrometry of Selenium: Part 1. Isotope Ratio Measurements and Determinations in Aquatic Systems with the Isotope Dilution Technique (Negative Thermionen-Massenspektrometrie von Selen: Teil 1. Isotopenverhaeltnismessungen sowie Konzentrationsbestimmungen in Aquatischen Systemen mit der Isotopenverduennungsanalyse),
W89-00737 5A

Determination of Substituted Aromatic Amines in Water and Sediment Samples,
W89-00738 5A

Determination of Organotins in Natural Waters by Toluene Extraction and Graphite Furnace AAS,
W89-00743 5A

Determination of Phosphate at Low Concentrations in Surface Waters by Flow-Injection Analysis,
W89-00931 5A

There's No Such Thing as a Representative Ground Water Sample,
W89-00937 5A

Making the Most of Field-Measurable Ground Water Quality Parameters,
W89-00939 7B

Reliability of Chemical Analyses of Water Samples: The Experience of the UMTRA Project,
W89-00941 5A

Use of Total Organic Carbon as an Indicator of Contamination from an Oil Refinery, South-Central Kansas,
W89-00942 5A

Sensitivity of Four Monitoring Well Sampling Systems to Low Concentration of Three Volatile Organics,
W89-00944 5A

Precipitation and Indirect Spectrophotometric Determination of Sulfate Traces in Fresh Water with Lead Nitrate and Tetraphenylporphine Trisulfonic Acid,
W89-01085 5A

Gas Chromatographic-Mass Spectrometric Investigations on Lipophilic Anthropogenic Substances in Environmental Samples. II: A Splitter for the Simultaneous Detection of Capillary Gas Chromatograms by up to Four Different GC-Detectors,
W89-01086 5A

Determination of Thiram in Water and Soils by Cathodic Stripping Voltammetry Based on Adsorptive Accumulation,
W89-01087 5A

Comparing Headspace with Purge and Trap for Analysis of Volatile Priority Pollutants,
W89-01119 5A

WATER BIRDS

Variations in the Use of the Bot River Estuary by Water-Birds,
W89-00661 2L

Ecological Role of the Red-Knobbed Coot, Fulica cristata Gmelin, at the Bot River Estuary, South Africa: A Preliminary Investigation,
W89-00662 2L

Recent Changes in Numbers of Waders on the Clyde Estuary, and Their Significance for Conservation,
W89-00810 5C

Patterns of Association Between Birds and Invertebrates in the Clyde Estuary,
W89-00811 2L

Population Dynamics of Seabirds in the Firth of Clyde,
W89-00822 2L

Variations in Polychlorinated Biphenyl Congener Composition in Eggs of Mediterranean Water Birds in Relation to their Position in the Food Chain,
W89-01056 5B

WATER CHEMISTRY

Nitrogen and Phosphorus Balance in Lake Szczytno Male,
W89-00240 2H

Hydrochemical Study of Lake Szczytno Male With Trout Cage Culture,
W89-00241 5B

Sorption Properties of Bottom Sediments of Szczytno Male and Letowo Lakes,
W89-00256 2H

Physical and Chemical Characteristics of the Waters of the Bot River Estuary, South Africa,
W89-00655 2L

Can the Redox Conditions in Natural Waters be Predicted by a Single Parameter,
W89-00688 2K

Interpretation and Measurement of Redox Intensity in Natural Waters: A Comment to T. Frevert's Paper, 'Can the Redox Conditions in Natural Waters be Predicted by a Single Parameter',
W89-00689 2K

Alkalinity Regulation in Softwater Florida Lakes,
W89-00714 2H

Definition of a Model for Monitoring the Chemical and Chemical-Physical Characteristics of Deep Drinking Waters,
W89-00927 7C

Potential Importance of Spatial and Temporal Heterogeneity in pH, Al, and Ca in Allowing Survival of a Fish Population: A Model Demonstration,
W89-01052 5C

Copper Binding by Dissolved Organic Matter: I. Suwannee River Fulvic Acid Equilibria,
W89-01077 5B

Copper Binding by Dissolved Organic Matter: II. Variation in Type and Source of Organic Matter,
W89-01078 5B

Surface Reactions of Synthetic, End-member Analogues of Monazite, Xenotime and Rhabdophane, and Evolution of Natural Waters,
W89-01080 2K

Solubility of Colloidal Ferric Hydroxide and its Relevance to Iron Concentrations in River Water,
W89-01081 2K

WATER CIRCULATION

Residual Fluxes of Water in an Estuarine Lagoon,
W89-00142 2L

Environmental Conditions in Abu Kir Bay, East of Alexandria: I. Physico-chemical Characteristics and Water Circulation,
W89-00565 5B

Experimental Determination of Salt Intrusion Mechanisms in the Volkerak Estuary,
W89-00667 2L

WATER CONSERVATION

Improving Canal Water Deliveries with Auxiliary Storage,
W89-00758 3B

Developing and Assessing a Model of Residential Water Conservation,
W89-00881 3D

National Water Management in the Republic of South Africa: Towards a Consultative Partnership with Diverse Users in a Semi-Arid Country,
W89-01029 6D

Changing Meaning of Water Conservation in the West,
W89-01269 6E

WATER CONVEYANCE

Programming Model for the Optimal Planning of Water Supply Systems,
W89-00452 6A

Water Supply and Sanitation - Cornerstones of the World Health Organization's Forty Years of International Health Development,
W89-00917 5F

Use of Network Analysis Techniques in the Development and Optimization of a large UK Urban Water Distribution System (L'Emploi de Techniques),
W89-00918 5F

Modern Management Standards of Water Network Register (Criteres Modernes de Gestion du Cadastre des Reseaux d'Eau),
W89-00919 5F

Petaling Jaya Non-Revenue Water Control Project Selangor, Malaysia,
W89-00923 5F

WATER COOLING
Monitoring of Liquid Effluents as Preventative Protection of Natural Bodies of Water (Abwasseruberwachung als vorbeugender Gewasserschutz),
W89-01184 5G

WATER COSTS
Optimization of the Production and Pumping Costs of the Nice Water Network (Optimisation de la Production et des Pompages sur le Reseau d'Eau de Nice),
W89-00922 5F

WATER CURRENTS
Origin and Size of Hypolimnic Mixing in Urnersee, the Southern Basin of Vierwaldstattersee (Lake Lucerne),
W89-00023 2H

Residual Fluxes of Water in an Estuarine Lagoon,
W89-00142 2L

Tidal Transport of Planktonic Copepods across the Sill of a British Columbia Fjord,
W89-00221 2L

Effects of Current Velocity on the Physical Structuring of Diatom (Bacillariophyceae) Communities,
W89-00686 2E

Water Movement and the Simulation of Storm Surges in the Firth of Clyde,
W89-00803 2L

Hydrography of Irvine Bay and Its Relation to the Clyde Sea Area,
W89-00805 2L

WATER DELIVERY
Improving Canal Water Deliveries with Auxiliary Storage,
W89-00758 3B

WATER DEMAND
Improving Canal Water Deliveries with Auxiliary Storage,
W89-00758 3B

Do Water Market Prices Appropriately Measure Water Values,
W89-00837 6D

Technology, Institutions, and Social Goals,
W89-00871 6D

National Water Management in the Republic of South Africa: Towards a Consultative Partnership with Diverse Users in a Semi-Arid Country,
W89-01029 6D

Analytical Simulation of Water System Capacity Reliability: 1. Modified Frequency-Duration Analysis,
W89-01240 5F

Analytical Simulation of Water System Capacity Reliability: 2. A Markov Chain Approach and Verification of the Models,
W89-01241 5F

WATER DISTRIBUTION
Networking Urban Water Supplies in West Africa,
W89-00419 5F

Contaminant Propagation in Distribution Systems,
W89-00494 5F

Comparison of Drinking Water Mutagenicity with Leaching of Polycyclic Aromatic Hydrocarbons from Water Distribution Pipes,
W89-00619 5C

Comparison of Bacterial Indicators and Sampling Programs for Drinking Water Systems,
W89-00733 5A

Improving Canal Water Deliveries with Auxiliary Storage,
W89-00758 3B

Use of Network Analysis Techniques in the Development and Optimization of a large UK Urban Water Distribution System (L'Emploi de Techniques),
W89-00918 5F

Modern Management Standards of Water Network Register (Criteres Modernes de Gestion du Cadastre des Reseaux d'Eau),
W89-00919 5F

Modeling Contaminant Propagation in Drinking Water Distribution Systems,
W89-00929 5F

Valves for Controlling Pressure, Flow and Level,
W89-01102 5F

Water Supply Yields Power,
W89-01254 8C

WATER DISTRICTS
Catalyst for Regionalization of Rural Water Systems,
W89-00883 6E

WATER EXCHANGE
Origin and Size of Hypolimnic Mixing in Urnersee, the Southern Basin of Vierwaldstattersee (Lake Lucerne),
W89-00023 2H

Large-Scale and Long-Term Variations in the Zooplankton Community of the Gullmar Fjord, Sweden, in Relation to Advective Processes,
W89-01038 2L

WATER HYACINTH
Effect of Gibberellic Acid and 2,4-D on Water Hyacinths,
W89-00105 4A

WATER LAW
Citizen Suits under the Clean Water Act: Waiting for Godot in the Fifth Circuit,
W89-00517 6E

Hazardous and Noxious Substances,
W89-00519 5G

International Control of Cross-Media Pollution: An Ecosystem Approach,
W89-00520 5G

Sierra Club v. Block, Wilderness Water Rights Protected Where Not in Conflict with Purposes of National Forest in Colorado,
W89-00522 6E

Regulation of Pollution: Controls and Responsibilities,
W89-00786 6E

Marine Pollution in Orkney,
W89-00796 5G

Survey of the International Law of Rivers,
W89-00835 6E

Groundwater Rights: Definition and Transfer,
W89-00838 6E

Clean Air Act-Transboundary Acid Rain Pollution Abatement-Administrative Discretion Citizen Suit,
W89-00839 5G

Water Rights: Enforcing the Federal-Indian Trust after Nevada v. United States,
W89-01010 6E

Cities Supported by Sticks in the Mud: A Variation on the Settlement of Land and Structures Caused by Ground Water Removal,
W89-01190 6E

Drafting Purchase and Sale Agreements Affecting Water Rights,
W89-01252 6E

Drafting Water Quality Agreements,
W89-01253 6E

New Directions in Nebraska Water Policy,
W89-01266 6E

State Equitable Apportionment of Western Water Resources,
W89-01267 6E

Recurring State Judicial Task of Choosing Rules for Groundwater Law: How Occult Still,
W89-01268 6E

Changing Meaning of Water Conservation in the West,
W89-01269 6E

WATER LEVEL
Hydraulic Tests for Reconstructing the Pumping Stations on the Moscow Canal,
W89-00055 8C

Annual Flow Statistics for Ungaged Streams in Idaho,
W89-00753 7C

Valves for Controlling Pressure, Flow and Level,
W89-01102 5F

WATER LEVEL FLUCTUATIONS
Great Lakes Shore Erosion,
W89-00133 4D

Effect of Seepage on Earth Dams,
W89-00550 8D

Hydrology of the Bot River Estuary,
W89-00654 2L

Subsurface Drainage Peak Flows in Shallow Soil,
W89-00749 4A

WATER LOSE
Petaling Jaya Non-Revenue Water Control Project Selangor, Malaysia,
W89-00923 5F

WATER LOSS
Stochastic Forecast of Water Losses,
W89-00759 7B

WATER MAINS
Contaminant Propagation in Distribution Systems,
W89-00494 5F

London Water Ring Main,
W89-00840 5F

WATER MANAGEMENT
Scientific Concepts and Methodologies Pertinent to Lake Research and Lake Restoration,
W89-00013 2H

Evaluation of Lake Restoration in Sweden,
W89-00021 5G

WATER MANAGEMENT

Water-Management Significance of the Moscow Canal,
W89-00050 3B

General Water Supply System Simulation Model: WASP,
W89-00299 5F

Multicriterion Stormwater Management Methods,
W89-00302 4A

Endangered Woundfin and Water Management in the Virgin River, Utah, Arizona, Nevada,
W89-00311 6G

Networking Urban Water Supplies in West Africa,
W89-00419 5F

Improving Water Supply in Thailand,
W89-00422 5F

Programming Model for the Optimal Planning of Water Supply Systems,
W89-00452 6A

Calculation of the Suspended Load in Rivers and Canals,
W89-00552 7B

Water Management for Lowland Rice Irrigation,
W89-00750 3F

Technology, Institutions, and Social Goals,
W89-00871 6D

River Regulation: A Regional Perspective - Northumbrian Water Authority,
W89-00950 4A

National Water Management in the Republic of South Africa: Towards a Consultative Partnership with Diverse Users in a Semi-Arid Country,
W89-01029 6D

WATER POLICY

Technology, Institutions, and Social Goals,
W89-00871 6D

Risk: A Key Water Policy Issue,
W89-01123 6D

Diffuse (Nonpoint) Pollution - A Political, Institutional, and Fiscal Problem,
W89-01134 5G

WATER POLLUTION

Toxicity of an Anionic Detergent to the Spawn and Larvae of Anurans (Amphibia),
W89-00139 5C

Water Quality of the Tisza River and the Alpar Backwater,
W89-00143 5B

Monitoring of Mercury Pollution in Dutch Coastal Waters by Means of the Teleostean Fish Zoarces Viviparus,
W89-00150 5C

New Aspects of the Sulfur Cycle, with Special Reference to Shallow Waters,
W89-00183 5B

Could Benthic Algae be used as Water Quality Indicators (Konnen Benthische Algen zur Wassergute-Bestimmung Herangezogen Werden),
W89-00194 5A

Preliminary Study on the Migration and Transformation of Heavy Metals in the Sewage-Seawater Mixing Zone of Jinzhou Bay, (in Chinese),
W89-00199 5B

Organochlorine Compounds in the Environment,
W89-00368 5C

Head-Space Analysis of Readily Volatile Chlorinated Hydrocarbons in Air and Water (Head-Space-Analytik Leichtfluechtiger Chlorkohlenwasserstoffe in Luft und Wasser),
W89-00504 5A

Mercury Pollution in the Estuarine Region around Bombay Island,
W89-00638 5B

Micronucleus Test: Examples of Application to Marine Ecology,
W89-01042 5A

Pesticides: A Continuing Dilemma,
W89-01122 5B

Monitoring of Liquid Effluents as Preventative Protection of Natural Bodies of Water (Abwasseruberwachung als vorbeugender Gewasserschutz),
W89-01184 5G

WATER POLLUTION CONTROL

Strategies of Lake Sanitation,
W89-00017 5G

Immobilization of Leachable Toxic Soil Pollutants by Using Oxidative Enzymes,
W89-00341 5G

Effectiveness of an Urban Runoff Detention Pond-Wetlands System,
W89-00487 5G

River Basin Water Quality Management in Stochastic Environment,
W89-00490 5G

Setting the Water Quality Agenda: 1988 and Beyond,
W89-00505 5G

Hazardous and Noxious Substances,
W89-00519 5G

Global Environment: A Proposal to Eliminate Marine Oil Pollution,
W89-00521 5G

Cost Efficiency of Transferable Discharge Permit Markets for Control of Multiple Pollutants,
W89-00697 5G

Regulation of Pollution: Controls and Responsibilities,
W89-00786 6E

Pollution Control and Environmental Planning for the Beatrice Oilfield and Nigg Oil Terminal,
W89-00788 5G

Marine Pollution in Orkney,
W89-00796 5G

Outstanding Problems in River Regulation,
W89-00963 4A

Problem with Nitrates,
W89-00965 5B

Evaluation of Vegetation Filter Strips as a Best Management Practice for Feed Lots,
W89-01125 5G

Diffuse (Nonpoint) Pollution - A Political, Institutional, and Fiscal Problem,
W89-01134 5G

Water Pollution Control in Dallas-Fort Worth,
W89-01233 5G

Waste Allocation Simulation Models,
W89-01234 5D

Anaerobic Treatment of Leachate Using Fixed Film and Sludge Bed Systems,
W89-01238 5D

WATER POLLUTION EFFECTS

Tumor Frequencies and Contaminant Concentrations in Brown Bullheads from an Industrialized River and a Recreational Lake,
W89-00028 5C

Longitudinal Changes in Fish Assemblages and Water Quality in the Willamette River, Oregon,
W89-00029 2H

Trace Element Content in Drinking Water of Nasopharyngeal Carcinoma Patients,
W89-00048 5C

Effect of a Heated Wastewater Discharge upon River Protozoan Species Pool Variability through Time and Space,
W89-00077 5C

Study of the Temperature Dependence of the Acute Toxicity of Pentachlorophenol to a Freshwater Pond Snail, Viviparus bengalensis L.,
W89-00078 5C

Pesticidal Effects on Chironomid Larvae,
W89-00079 5C

Heavy-Metal Toxicity in the Cyanobacterium Nostoc linckia,
W89-00094 5C

Photosynthesis of Submersed Macrophytes in Acidified Lakes: II. Carbon Limitation and Utilization of Benthic CO2 Sources,
W89-00095 5C

Effects of the Season and of Water Chemistry on the Decomposition of Nymphaea alba L.: Weight Loss and Pyrolysis Mass Spectrometry of the Particulate Matter,
W89-00096 2H

Leaf Production and Nitrogen and Phosphorus Tissue Content of Littorella uniflora (L.) Aschers. in Relation to Nitrogen and Phosphorus Enrichment of the Sediment in Oligotrophic Lake Hampen, Denmark,
W89-00101 5C

Richness of Aquatic Macrophyte Floras of Soft Water Lakes of Differing pH and Trace Metal Content in Ontario, Canada,
W89-00103 5C

Ammonium and Nitrate Uptake by Aquatic Plants from Poorly Buffered and Acidified Waters,
W89-00112 5C

Loss of Seagrass in Cockburn Sound, Western Australia: II. Possible Causes of Seagrass Decline,
W89-00116 5C

Effects of Light Intensity on Growth of Azolla pinnata Cultured in Effluent Collected from the Banka Stream in West Bengal, India,
W89-00127 5C

Scanning Electron Microscopy of Bacteria and Diatoms Attached to a Submerged Macrophyte in an Increasingly Polluted Stream,
W89-00132 5C

Effect of 3,4 Benzopyrene on the Photosynthetic and Respiratory Intensity of the Green Alga Scenedesmus quadricaud» (Der Einfluss von 3,4-Benzpyren aud die Photosynthese- une Respirationsintensitat der Gruenalge Scenedesmus quadricauda),
W89-00135 5C

Water Quality of the Tisza River and the Alpar Backwater,
W89-00143 5B

Tisza Water, as Irrigation Water, Polluted with Various Compounds,
W89-00145 3C

Monitoring of Mercury Pollution in Dutch Coastal Waters by Means of the Teleostean Fish Zoarces Viviparus,
W89-00150 5C

Modelling Research on the Production Cycle of Phytoplankton in the Southern Bight of the North Sea in Relation to Riverborne Nutrient Loads,
W89-00157 2L

Role of Sewage Effluent in the Accumulation of Macroalgal Mats on Intertidal Mudflats in Two Basins in Southern England,
W89-00159 5C

Investigations of the Ecotoxicological Effect of an Herbicide in an Aquatic Model Ecosystem: II. Food Chain Significance and Pesticide Balance (Untersuchungen zur okotoxikologischen Wirkung eines Herbizids in einem aquatischen Modellokosystem: II. Nahrungskettenprobleme und Schadstoffbilanzierung),
W89-00175 5C

Model Ecosystems as a Tool in Freshwater and Marine Research,
W89-00180 5B

Biochemical Models for the Hypolimnetic Oxygen Depletion in Lakes Impacted by Wastewater Discharges: 1. Alternative models,
W89-00186 5C

Biochemical Models for the Hypolimnetic Oxygen Depletion in Lakes Impacted by Wastewater Discharges: 2. Phytoplankton Biomass Model,
W89-00189 5C

Limits of Growth of Five Chlorella Species in the Presence of Toxic Heavy Metals,
W89-00191 5C

Growth and Conversion Efficiency of the Catfish Heteropneustes fossilis (Bloch) Exposed to Sub-Lethal Concentrations of Sodium Pentachlorophenate,
W89-00243 5C

Acute Toxicity of Ammonia to Common Carp (Cyprinus carpio L.),
W89-00244 5C

Estimation of Phytoplankton Biomass and Production, and Organic Matter Decomposition in Three Small Field-Ponds,
W89-00252 2H

Contemporary Changes in Coastal Biocenoses of the Gdansk Bay (South Baltic), A Review,
W89-00254 2L

Impact of Manganese Intoxication on the Blood Pyruvic Acid of a Freshwater Tropical Perch Colisa fasciatus,
W89-00263 5A

Effects of Disturbance and Severe Seasonal Fluctuations in Environmental Conditions on North Temperate Shallow-water Fish Assemblages,
W89-00282 2L

Spartina alterniflora Die-Back in Louisiana: Time-Course Investigation of Soil Waterlogging Effects,
W89-00286 2H

Physiological Effects on Coho Salmon and Steelhead of Exposure to Suspended Solids,
W89-00292 5C

Effect of Low pH on Survival of Brook Trout Embryos and Yolk-Sac Larvae in West Virginia Streams,
W89-00293 5C

Baseline Study of Jordan Creek, City of Allentown, Lehigh County, Pennsylvania,
W89-00313 5C

Periphyton, Benthic Invertebrates and Fishes as Biological Indicators of Water Quality in the East Branch Brandywine Creek,
W89-00314 5A

Developmental Defects in Pelagic Fish Embryos from the Western Baltic,
W89-00315 5C

Soft Bottom Fauna Near the River Elbe Estuary under the Influence of Sewage Sludge. I. Seasonal Variation of Species Number, Abundance and Biomass in Relation to Sediment Structure (Die Weichbodenfauna vor der Elbemuendung unter dem Einfluss der Klaerschlammverklappung. I. Die Saisonale Veraenderung von Arten- und Individuenzahl sowie Biomasse unter Beruecksichtigung der Sedimentstrucktur),
W89-00316 5C

Sensitivity of Young Striped Bass to Organic and Inorganic Contaminants in Fresh and Saline Waters,
W89-00320 5C

Avoidance of a Water-Soluble Fraction of Coal Liquid by Fathead Minnows,
W89-00321 5C

Application and Testing of an Index of Biotic Integrity in Small, Coolwater Streams,
W89-00323 2H

Waste Transformer Oil and PCB Toxicity to Rainbow Trout,
W89-00328 5C

Leaching of Retorted Oil Shale: Assessing the Toxicity to Colorado Squawfish, Fathead Minnows, and Two Food-Chain Organisms,
W89-00329 5C

Acute Toxicity of Thiocyanate to Trout,
W89-00330 5C

Environmental Effects of Paper Industry Wastewaters: An Overview,
W89-00362 5C

Physiological Disturbances in Fish Exposed to Bleached Kraft Mill Effluents,
W89-00363 5C

Sublethal Effects of Chlorinated Phenols and Resin Acids on Rainbow Trout (Salmo gairdneri),
W89-00364 5C

Effects of Pulp Mill Effluents on Skeletal Parameters in Fish: A Progress Report,
W89-00365 5C

Effects of Pulp Mill Effluent on a Baltic Coastal Fish Community,
W89-00366 5C

Effects of a Bleached Pulp Mill Effluent on Growth and Gonad Function in Baltic Coastal Fish,
W89-00367 5C

Organochlorine Compounds in the Environment,
W89-00368 5C

Mutagenicity in Pulp and Paper Mill Effluents and in Recipient,
W89-00370 5C

Homing of Adult Chinook Salmon after Brief Exposure to Whole and Dispersed Crude Oil,
W89-00375 5C

Comparison of Laboratory and Field Observations of Fish Exposed to the Herbicides Molinate and Thiobencarb,
W89-00376 5C

Influence of pH and Ammonia Salts on Ammonia Toxicity and Water Balance in Young Channel Catfish,
W89-00377 5C

Corneal Damage in Larvae of Striped Bass Morone saxatilis Exposed to Copper,
W89-00380 5C

Effects of Organic Contaminants on Reproduction of the Starry Flounder Platichthys stellatus in San Francisco Bay. I. Hepatic Contamination and Mixed-Function Oxidase (MFO) Activity During the Reproductive Season,
W89-00385 5C

Acute Toxicities of Eleven Metals to Early Life-History Stages of the Yellow Crab Cancer anthonyi,
W89-00386 5C

Biochemical Composition of the Blue Crab Callinectes sapidus Exposed to the Water-Soluble Fraction of Crude Oil,
W89-00391 5C

Summary of Reported Fish Kills in Kansas During 1982,
W89-00393 5C

Macroinvertebrate Populations in a Thermally Impacted Reservoir,
W89-00397 5C

Effect of pH and Total Ion Concentration on Growth Rate of Chironomus nr. maturus Larvae (Diptera: Chironomidae) from an Acid Strip-Mine Lake,
W89-00399 5C

Effects of Disturbances Along Hydroelectrical Transmission Corridors Through Peatlands in Northern Manitoba, Canada.
W89-00436 4C

Sensitivity of Coral Reefs to Environmental Pollution,
W89-00440 5C

Depressed Mercury Levels in Biota from Acid and Metal Stressed Lakes Near Sudbury, Ontario,
W89-00442 5B

Ecological and Saprobiological Status of the Rhine (Der Oekologisch-Saprobiologische Zustand des Rheins),
W89-00498 2H

Effects of Six Heavy Metals on Hatching Eggs and Survival of Larva of Marine Fish, (in Chinese),
W89-00533 5C

Transient Liver Pathology in Patients Consuming Water from a Private Well Contaminated by PCBs from a Submersible Water Pump,
W89-00558 5C

Method to Assess Periodic Responses of Aquatic Microecosystems to Photosynthetic Inhibition,
W89-00562 7B

Ecological Parameter of Surface Water in Northeastern Greece,
W89-00564 5B

WATER POLLUTION EFFECTS

Environmental Conditions in Abu Kir Bay, East of Alexandria: II. Plankton Distribution, Downstream from Land-Based Effluents,
W89-00578 5C

Association Between Seawater Pollution as Measured by Bacterial Indicators and Morbidity Among Bathers at Mediterranean Bathing Beaches of Israel,
W89-00579 5C

Influence of Chemicals upon Plankton in Freshwater Systems,
W89-00581 5C

Effects of High Levels of Polycyclic Aromatic Hydrocarbons on Sediment Physicochemical Properties and Benthic Organisms in a Polluted Stream,
W89-00589 5C

Predictive Structure-Toxicity Model with Daphnia magna,
W89-00591 5C

Effects of Lindane and Atropine Sulphate on the Tissues of the Fish, Anabas testudineus (Bloch): A Chronotoxicological Approach,
W89-00594 5C

Photo-induced Toxicity of Polycyclic Aromatic Hydrocarbons to Larvae of the Fathead Minnow (Pimephales promelas),
W89-00595 5C

Characteristics of Soil after Pollution with Waste Waters from Olive Oil Extraction Plants,
W89-00602 5C

Long-term Study of Ecosystem Contamination with 2,3,7,8-Tetrachlorodibenzo-p-dioxin,
W89-00603 5B

Comparison of Drinking Water Mutagenicity with Leaching of Polycyclic Aromatic Hydrocarbons from Water Distribution Pipes,
W89-00619 5C

Effects of Oil Contamination on Colonization of Marine Periphytic Microflora,
W89-00681 5C

Snail Distributions in Lake Erie: The Influence of Anoxia in the Southern Central Basin Nearshore Zone,
W89-00683 2A

Impact of a Municipal Wastewater Effluent on Water Quality, Periphyton, and Invertebrates in the Little Miami River Near Xenia, Ohio,
W89-00685 5C

Seasonal Changes of the Profundal Macrobenthic Community in a Polluted Lake,
W89-00693 5C

Comparison of Robust Bayes and Classical Estimators for Regional Lake Models of Fish Response to Acidification,
W89-00713 5C

Metabolic Processes Involved in Repair of Escherichia coli Cells Damaged by Exposure to Acid Mine Water,
W89-00727 5C

Effects of Acidification on Mercury Methylation, Demethylation, and Volatilization in Sediments from an Acid-Susceptible Lake,
W89-00731 5B

Oil Pollution in the Cromarty Firth and Inshore Moray Firth,
W89-00785 5B

Monitoring the Moray Firth Environment,
W89-00787 5C

Attached Algae of the Clyde and Garnock Estuaries,
W89-00807 5C

Status of Fish Populations in the Clyde Estuary,
W89-00809 2L

Recent Changes in Numbers of Waders on the Clyde Estuary, and Their Significance for Conservation,
W89-00810 5C

Patterns of Association Between Birds and Invertebrates in the Clyde Estuary,
W89-00811 2L

Benthic Fauna of Sandy Bays, with Particular Reference to Irvine Bay,
W89-00819 5C

Benthos of the Deeper Sediments of the Firth of Clyde, with Particular Reference to Organic Enrichment,
W89-00820 5C

Recent Changes in the Status of Some Clyde Vertebrates,
W89-00826 5C

Differences in the Spectral Characteristics of Birch Canopies Exposed to Simulated Acid Rain,
W89-00849 5C

Fish, Fleas and Phytoplankton,
W89-00851 5C

Pollution Beneath the Golden Gate,
W89-00852 5C

Sea-Surface Microlayer of Puget Sound: Part I: Toxic Effects on Fish Eggs and Larvae,
W89-00853 5C

Sea-Surface Microlayer of Puget Sound: Part II: Concentrations of Contaminants and Relation to Toxicity,
W89-00854 5C

Toxicity of Sea-Surface Microlayer: Effects On Herring and Turbot Embryos,
W89-00855 5C

Contaminant Concentrations and Toxicity of Sea-Surface Microlayer Near Los Angeles, California,
W89-00857 5C

Laboratory Study of the Accumulation and Toxicity of Contaminants at the Sea Surface from Sediments Proposed for Dredging,
W89-00858 5E

Hepatic Lesions in English Sole (Parophrys vetulus) from Commencement Bay, Washington (USA),
W89-00859 5C

Induced Resistance to Polychlorinated Biphenyls Confers Cross-Resistance and Altered Environmental Fitness in a Marine Diatom,
W89-00860 5C

Tropical Eutrophic Lake Modeling and Parameter Discrimination,
W89-00872 2H

Assessing the Birkenes Model of Stream Acidification Using a Multisignal Calibration Methodology,
W89-00974 7B

Terrestrial Bioaccumulation Potential of Phenolic Compounds,
W89-00998 5B

Population Genetics of Mytilus edulis (L.) from Oslofjorden, Norway in Oil-Polluted and Non Oil-Polluted Water,
W89-01009 5C

Results of Ecological Monitoring of Three Beaches Polluted by the 'Amoco Cadiz' Oil Spill: Development of Meiofauna from 1978 to 1984,
W89-01031 5C

Potential Importance of Spatial and Temporal Heterogeneity in pH, Al, and Ca in Allowing Survival of a Fish Population: A Model Demonstration,
W89-01052 5C

Organochlorines and Eggshell Thinning in Northern Gannets (Sula bassanus) from Eastern Canada, 1968-1984,
W89-01054 5C

Acute and Chronic Toxicity of Triphenyltin Hydroxide to Fathead Minnows (Pimephales promelas) Following Brief or Continuous Exposure,
W89-01057 5C

Effects of a Simulated Acid Precipitation on Leaf Litter Quality and the Growth of a Detritivore in a Buffered Lotic System,
W89-01058 5C

Utility of Laboratory Streams for Ecosystem Toxicity Studies,
W89-01059 5B

Effects of Discharge Fluctuation and the Addition of Fine Sediment on Stream Fish and Macroinvertebrates Below a Water-Filtration Facility,
W89-01061 5C

Effects of Cadmium on Early Developmental Stages of the Sheepshead Minnow (Cyprinodon Variegatus),
W89-01091 5C

Effects of Acute Exposure to Acidified Water on the Behavorial Response of Fathead Minnows, Pimephales Promelas, to Alarm Substance (Schreckstoff),
W89-01092 5C

Pesticides: A Continuing Dilemma,
W89-01122 5B

Sensitivity of Freshwater Pulmonate Snails, Lymnaea luteola L., to Heavy Metals,
W89-01154 5C

Branchial and Renal Pathology in the Fish Exposed Chronically to Methoxy Ethyl Mercuric Chloride,
W89-01156 5C

Toxicity of Alkyllead Salts to Anaerobic Nitrogen Transformations in Sediment,
W89-01167 5C

Stream Acidification Trends in the Welsh Uplands: A Modelling Study of the Llyn Brianne Catchments,
W89-01206 5C

Evaluation and Comparison of Two Short-Term Fathead Minnow Tests for Estimating Chronic Toxicity,
W89-01224 5A

Assessment of Selenium Toxicity in Algae Using Turbidostat Culture,
W89-01230 5C

WATER POLLUTION PREVENTION

State Program Solves County Salt Storage Problem,
W89-00466 5G

Citizen Suits under the Clean Water Act: Waiting for Godot in the Fifth Circuit,
W89-00517 6E

Encapsulated Herbicides Could Curb Ground Water Pollution,
W89-00964 5G

Role of Economic Benefits Analysis in Funding Marine Combined Sewer Overflow Projects - Case Study of Boston Harbor,
W89-01132 6C

WATER POLLUTION SOURCE

Some Hydrochemical, Hydrobiological, and Ichthyological Features of Yugoslav Part of the Danube Lasting for Several Years (Einige hydrochemische, hydrobiologische und ichthyologische Eigenschaften der jugoslawischen Donaustrecke in mehrjahrigem Zeitraum),
W89-00165 5C

WATER POLLUTION SOURCES

Role of External Ammonium Inputs in Freshwater Acidification,
W89-00024 5B

Natural Degradation Ability of Lakes and the Role of Drainage Area in the Process (Ocena naturalnej podatnosci jezior na degradacje i rola zlewni u tym procesie),
W89-00032 2H

Nitrogen Budget of the Scheldt Hydrographical Basin,
W89-00155 5B

Viral Pollution of Surface Waters by Domestic Waste Water Discharge (Die Viral-Verunreinigung der Oberflachengewasser durch Ableiten der Haushaltsabwasser),
W89-00170 5B

Biochemical Models for the Hypolimnetic Oxygen Depletion in Lakes Impacted by Wastewater Discharges: 1. Alternative models,
W89-00186 5C

Characteristics of Distribution and Migration of Phosphorus in Deposits of Dianchi Lake, (in Chinese),
W89-00200 5B

Hydrochemical Study of Lake Szczytno Male With Trout Cage Culture,
W89-00241 5B

Field Study of the Cloud Chemistry and Cloud Microphysics at Great Dun Fell,
W89-00308 5B

Testing a Comprehensive Acid Deposition Model,
W89-00310 5B

Summary of Reported Fish Kills in Kansas During 1982,
W89-00393 5C

Seasonal and Temporal Changes of Organic Compounds in Rain and Snow,
W89-00429 5B

Rain-Aerosol Coupling in Urban Area: Scavenging Ratio Measurement and Identification of Some Transfer Processes,
W89-00430 2B

Atmospheric Deposition of Arsenic and Association with Acid Precipitation,
W89-00431 5B

Changes in Soil Acidity in Two Forest Areas with Different Acid Deposition: 1920s to 1980s,
W89-00444 5B

Rain Acidity in Stellenbosch,
W89-00454 5A

Motor-Boat-Derived Volatile Organic Compounds (VOC) in Lake water,
W89-00499 5B

Transient Liver Pathology in Patients Consuming Water from a Private Well Contaminated by PCBs from a Submersible Water Pump,
W89-00558 5C

Sources of Watercourse Pollution in Italy and Mediterranean France, Assessed by Macrophytes,
W89-00563 5B

Ecological Parameter of Surface Water in Northeastern Greece,
W89-00564 5B

Environmental Conditions in Abu Kir Bay, East of Alexandria: I. Physico-chemical Characteristics and Water Circulation,
W89-00565 5B

Correlation of Some Organic Pollution Factors in Water Systems in Northern Greece,
W89-00566 5B

Boron Levels in Some Ground Waters of Halkidiki (A Land at Northern Aegean Sea),
W89-00569 5B

Two Toxicants, Mercury and Tin in the Gulf of Iskenderun,
W89-00570 5B

Bacteriological Contamination of the Eastern Part of the Gulf of Trieste (North Adriatic) Due to Sewage Discharge,
W89-00577 5B

Coordinated Programme for Research and Monitoring of Pollution in the Mediterranean,
W89-00582 5A

Formation of 1-Nitropyrene by Photolysis of Pyrene in Water Containing Nitrite Ion,
W89-00586 5B

Investigation of the Production of Lipophilic Volatile Organohalogen Materials during Laboratory Chlorination of some Ground Water Samples from Yugoslavia,
W89-00608 5F

Contributions of Heavy Metals from Municipal Runoff to the Sediments of Lake Pontchartrain, Louisiana,
W89-00618 5B

Comparison of Drinking Water Mutagenicity with Leaching of Polycyclic Aromatic Hydrocarbons from Water Distribution Pipes,
W89-00619 5C

Chloropicrin in Potable Water: Conditions of Formation and Production during Treatment Processes (La Chloropicrine dans les Eaux Potables: Conditions de Formation et Evolution le long des Filieres de Traitement),
W89-00635 5F

Mercury Inputs into the Amazon Region, Brazil,
W89-00637 5B

Distribution of Arsenic in the Sediments and Biota of Hilo Bay, Hawaii,
W89-00677 5B

Contamination of Surface Sediments of the Principal Rivers of Geneva Canton by Polychlorinated Biphenyls and DDT (Contamination des Sediments Superficiels des Principales Rivieres du Canton de Geneve par les Polychlorobiphenyles et DDT),
W89-00690 5B

Interpretation of Metal Profiles in a Sediment Core from Lake Geneva: Metal Mobility or Pollution,
W89-00694 5B

Evaluation of the Sulfur(IV) Catalyzed Autoxidation of Cobalt(II) in an Azide Containing Medium as a Means for the Determination of Sulfite in Precipitation,
W89-00736 5A

Oil Pollution in the Cromarty Firth and Inshore Moray Firth,
W89-00785 5B

Monitoring the Moray Firth Environment,
W89-00787 5C

Water Quality in the Inverness and Beauly Firths,
W89-00789 5B

Hydrocarbons in Nigg Bay Sediments,
W89-00790 5B

Hydrocarbon and Pollutant Levels in the Cromarty Firth,
W89-00791 5B

Other Forms of Environmental Pollution,
W89-00794 5B

Use of the Clyde Estuary and Firth for the Disposal of Effluents,
W89-00824 5E

Effects of Sulphur Deposition on Lake-Water Chemistry in Ontario, Canada,
W89-00846 5B

Pollution Beneath the Golden Gate,
W89-00852 5C

Sea-Surface Microlayer of Puget Sound: Part II: Concentrations of Contaminants and Relation to Toxicity,
W89-00854 5C

Acidification of Shallow Groundwaters During the Spring Melt Period,
W89-00893 5B

Modelling the Effects of Acid Deposition: Estimation of Long-Term Water Quality Responses in Forested Catchments in Finland,
W89-00894 5B

Problem with Nitrates,
W89-00965 5B

Aluminum Speciation in Surface Waters from a Welsh Upland Area,
W89-01055 5B

Accumulation of Polycyclic Aromatic Hydrocarbons in Acid Sensitive Lakes,
W89-01074 5B

Variability of Dissolved Trace Metals in the Mississippi River,
W89-01075 5B

Radionuclides in Drinking Water,
W89-01104 5B

Occurrence of Radon in Well Supplies,
W89-01105 5B

Occurrence of Radon, Radium, and Uranium in Groundwater,
W89-01108 5B

Source Protection and the Small Utility,
W89-01116 5G

Influence of Altitude on Rainfall Composition at Great Dun Fell,
W89-01146 5B

WATER POLLUTION SOURCES

Influence of Altitude on Wet Deposition: Comparison between Field Measurements at Great Dun Fell and the Predictions of a Seeder-Feeder Model,
W89-01147 5B

Occurrence and Distribution of Trace Organic Compounds in Bermuda Precipitation,
W89-01148 5B

Acidic Deposition Distribution and Episode Statistics from the MAP3S Network Database,
W89-01151 5B

Mercury in Freshwater Fish and Clams from the Cerro Prieto Geothermal Field of Baja California, Mexico,
W89-01153 5B

Septic System Performance on a Coastal Barrier Island,
W89-01163 5D

Hydrogen Ion Concentration and Alkalinity of Reservoir Water in the Sierra Nevada, California, and Correlations with Air Pollutants,
W89-01165 5B

Toxicity of Alkyllead Salts to Anaerobic Nitrogen Transformations in Sediment,
W89-01167 5C

Bacterial Water Quality Responses to Four Grazing Strategies: Comparisons with Oregon Standards,
W89-01170 5B

Shallowly Placed, Low Pressure Distribution System to Treat Domestic Wastewater in Soils with Fluctuating High Water Tables,
W89-01171 5D

Atmospheric Deposition of Polycyclic Aromatic Hydrocarbons to Water Surfaces: A Mass Balance Approach,
W89-01257 5B

Relative Roles of Emissions Changes and Meteorological Variability of Wet sulfur Deposition: A Trajectory Model Study,
W89-01259 5B

Aspects of Atmospheric Pollutant Origin and Deposition Revealed by Multielemental Observations at a Rural Location in Eastern Canada,
W89-01264 5B

Winter Cloud Water and Air Composition in Central Ontario,
W89-01265 5C

WATER POLLUTION TREATMENT

Chemical Methods of P-Elimination in the Tributaries of Reservoirs and Lakes,
W89-00020 5G

Nonaqueous Phase Liquid Transport and Cleanup: I. Analysis of Mechanisms,
W89-00968 5B

Nonaqueous Phase Liquid Transport and Cleanup: II. Experimental Studies,
W89-00969 5B

Coping with Groundwater Contamination,
W89-01135 5G

WATER POLLUTION TREATMENTS

Scientific Concepts and Methodologies Pertinent to Lake Research and Lake Restoration,
W89-00013 2H

WATER PRESSURE

Valves for Controlling Pressure, Flow and Level,
W89-01102 5F

WATER PROPERTIES

Can the Redox Conditions in Natural Waters be Predicted by a Single Parameter,
W89-00688 2K

Interpretation and Measurement of Redox Intensity in Natural Waters: A Comment to T. Frevert's Paper, 'Can the Redox Conditions in Natural Waters be Predicted by a Single Parameter',
W89-00689 2K

WATER QUALITY

Spatial and Temporal Variability of the Index of Biotic Integrity in Three Midwestern Streams,
W89-00026 2E

Longitudinal Changes in Fish Assemblages and Water Quality in the Willamette River, Oregon,
W89-00029 2H

Water Quality of the Tisza River and the Alpar Backwater,
W89-00143 5B

Impact of Impounding on the Oxygen Balance of the Danube from Kelheim to Jochenstein Microbiological-Biochemical Investigations and Water Quality Model Calculations (Zum Einfluss der Strauregulierung auf den Sauerstoffhaushalt der Donaustrecke Kelheim-Jochenstein: Mikrobiologisch-biochemische Untersuchungen und Gutemodellrechnungen),
W89-00173 6G

Detection and Enumeration of Actinomycetes in the Austrian Part of the Danube by Means of Selective Membrane Filtration Methods Together With Some Other Bacteriological Parameters (Nachweis und Vorkommen von Actinomyceten in der osterreichischen Donau mittels selektiver Membranfilterverfahren, zusammen mit einigen anderen bakteriologischen Parametern),
W89-00174 5A

Could Benthic Algae be used as Water Quality Indicators (Konnen Benthische Algen zur Wassergute-Bestimmung Herangezogen Werden),
W89-00194 5A

Indicatory Role of Some Invertebrates for Quality of Water in the Vistula River and in Subsequent Stages of Its Treatment,
W89-00236 5A

Application and Testing of an Index of Biotic Integrity in Small, Coolwater Streams,
W89-00323 2H

Fecal Coliform Fingertip Count: A Potential Method for Evaluating the Effectiveness of Low Cost Water Supply and Sanitation Initiatives,
W89-00379 5G

Trihalomethane Formation in High-Bromide Lake Galilee Water,
W89-00426 5F

Effects of Discontinuing Disinfection on a Receiving Water,
W89-00515 5D

Environmental Conditions in Abu Kir Bay, East of Alexandria: I. Physico-chemical Characteristics and Water Circulation,
W89-00565 5B

Nonparametric Approaches to Environmental Impact Assessment,
W89-00861 7C

Statistical Methods and Sampling Design for Estimating Step Trends in Surface-Water Quality,
W89-00862 7A

Multivariate Nonparametric Tests for Trend in Water Quality,
W89-00863 7C

Tau-Like Test for Trend in the Presence of Multiple Censoring Points,
W89-00865 7C

Data Analysis of Water Quality Time Series in Lake Erie,
W89-00866 7C

Nonparametric Tests for Trend Detection in Water Quality Time Series,
W89-00867 7C

Comparison of Instream and Laboratory Methods of Measuring Sediment Oxygen Demand,
W89-00869 7B

Recreation Resource Allocation Model for Public Drinking Reservoirs,
W89-00921 6D

Definition of a Model for Monitoring the Chemical and Chemical-Physical Characteristics of Deep Drinking Waters,
W89-00927 7C

There's No Such Thing as a Representative Ground Water Sample,
W89-00937 5A

Reliability of Chemical Analyses of Water Samples: The Experience of the UMTRA Project,
W89-00941 5A

Contamination of Farmstead Wells by Pesticides, Volatile Organics, and Inorganic Chemicals in Kansas,
W89-00946 5B

River Regulation: A Regional Perspective - Northumbrian Water Authority,
W89-00950 4A

Water Resources, Salinity and Salt Yields of the Rivers of the Bolivian Amazon,
W89-01213 2E

Drafting Water Quality Agreements,
W89-01253 6E

Water Supply Yields Power,
W89-01254 8C

WATER QUALITY CONTROL

Food Web Manipulation Without Nutrient Control: A Useful Strategy in Lake Restoration,
W89-00019 5G

Experiences of Long-term Destratification in a Water Supply Impoundment in Central Illinois,
W89-00403 5G

Improving Water Supply in Thailand,
W89-00422 5F

Eutrophication of Lakes and Reservoirs: A Framework for Making Management Decisions,
W89-00439 5C

Delayed Nutrient Responses to the Liming of Lake Gardsjon, Sweden,
W89-00441 5G

Mixing of Temperature-Stratified Lakes and Reservoirs by Buoyant Jets,
W89-00492 5G

Ecological and Saprobiological Status of the Rhine (Der Oekologisch-Saprobiologische Zustand des Rheins),
W89-00498 2H

Load Allocation for Toxics Using Monte Carlo Techniques,
W89-00514 5G

Sources of Watercourse Pollution in Italy and Mediterranean France, Assessed by Macrophytes,
W89-00563 5B

Comparison of Bacterial Indicators and Sampling Programs for Drinking Water Systems,
W89-00733 5A

Water Quality in the Inverness and Beauly Firths,
W89-00789 5B

Nonaqueous Phase Liquid Transport and Cleanup: I. Analysis of Mechanisms,
W89-00968 5B

Nonaqueous Phase Liquid Transport and Cleanup: II. Experimental Studies,
W89-00969 5B

National Water Management in the Republic of South Africa: Towards a Consultative Partnership with Diverse Users in a Semi-Arid Country,
W89-01029 6D

Source Protection and the Small Utility,
W89-01116 5G

Monitoring of Liquid Effluents as Preventative Protection of Natural Bodies of Water (Abwasseruberwachung als vorbeugender Gewasserschutz),
W89-01184 5G

WATER QUALITY MANAGEMENT

River Basin Water Quality Management in Stochastic Environment,
W89-00490 5G

Setting the Water Quality Agenda: 1988 and Beyond,
W89-00505 5G

Procedure for Evaluating Municipal Solid Waste Leachate Components Capable of Causing Volume Shrinkage in Compacted Clay Soils,
W89-00621 5E

Lake Treatment with Alum,
W89-00745 5G

Water Quality Management: A Regional Perspective-The Severn-Trent Area,
W89-00951 5G

WATER QUALITY STANDARDS

Bacterial Water Quality Responses to Four Grazing Strategies: Comparisons with Oregon Standards,
W89-01170 5B

Waste Allocation Simulation Models,
W89-01234 5D

WATER RATES

Do Water Market Prices Appropriately Measure Water Values,
W89-00837 6D

Effects of Rate Structure Knowledge on Household Water Use,
W89-00877 6D

WATER RESOURCES DEVELOPMENT

50th Anniversary of the Moscow Canal,
W89-00049 8A

Small Hydroelectric Stations and Prospects of Their Development,
W89-00059 8C

Development and Management of Groundwater Resources on Diego Garcia,
W89-00423 4B

Coastal Planning in the Moray Firth,
W89-00777 2L

Future Prospects for Hydro Electricity and Windpower,
W89-00793 6C

Politics of Hydro-Megaprojects: Damming with Faint Praise in Australia, New Zealand, and British Columbia,
W89-00836 6E

Do Water Market Prices Appropriately Measure Water Values,
W89-00837 6D

Groundwater Rights: Definition and Transfer,
W89-00838 6E

Water Resources, Salinity and Salt Yields of the Rivers of the Bolivian Amazon,
W89-01213 2E

WATER RESOURCES MANAGEMENT

Issues in Rule Base Development,
W89-00305 6A

Remote Sensing Applications in Water Resource Prospecting and Management,
W89-00459 7B

WATER RESUSE

Testing the Secondary Treatment of Effluents from the 'Police' Chemical Plant in Carp Ponds,
W89-00255 5D

WATER REUSE

High Level Disinfection of Wastewaters for Reuse,
W89-00642 5D

Viability Determination of Ascaris Eggs Recovered from Waste-Water,
W89-00644 5A

Formation of Hydrous Zirconium (IV) Oxide Polyelectrolyte Membranes, I. Poly (itaconic acid) and Poly (acrylic-co-itaconic acid),
W89-01062 3A

WATER RIGHTS

Groundwater Rights: Definition and Transfer,
W89-00838 6E

Management of a Tributary Aquifer,
W89-00978 4B

Water Rights: Enforcing the Federal-Indian Trust after Nevada v. United States,
W89-01010 6E

Drafting Purchase and Sale Agreements Affecting Water Rights,
W89-01252 6E

WATER SAMPLING

Statistical Methods and Sampling Design for Estimating Step Trends in Surface-Water Quality,
W89-00862 7A

There's No Such Thing as a Representative Ground Water Sample,
W89-00937 5A

Making the Most of Field-Measurable Ground Water Quality Parameters,
W89-00939 7B

Oxygen Transfer Through Flexible Tubing and Its Effects on Ground Water Sampling Results,
W89-00943 5A

Sensitivity of Four Monitoring Well Sampling Systems to Low Concentration of Three Volatile Organics,
W89-00944 5A

Screened Auger Sampling: The Technique and Two Case Studies,
W89-00945 5A

Discrete Point Sampler for Ground Water Monitoring Wells,
W89-00947 7B

Simple, Reliable, and Inexpensive Pore-Water Sampler,
W89-01051 7B

Is Water a Relevant Sampling Medium for Toxic Chemicals: An Alternative Environmental Sensing Strategy,
W89-01162 5A

WATER SOFTENING

Central Softening by Crystallization in a Fluidized-Bed Process,
W89-00421 5F

Properties of Water Treatment Lime Sludges and Their Effectiveness as Agricultural Limestone Substitutes,
W89-00516 5F

STASOFT: A User-Friendly Interactive Computer Program for Softening and Stabilisation of Municipal Waters,
W89-00935 5F

WATER SOURCE PROTECTION

Source Protection and the Small Utility,
W89-01116 5G

WATER SUPPLY

General Water Supply System Simulation Model: WASP,
W89-00299 5F

Fecal Coliform Fingertip Count: A Potential Method for Evaluating the Effectiveness of Low Cost Water Supply and Sanitation Initiatives,
W89-00379 5G

Networking Urban Water Supplies in West Africa,
W89-00419 5F

Improving Water Supply in Thailand,
W89-00422 5F

Development and Management of Groundwater Resources on Diego Garcia,
W89-00423 4B

Twinning: Utility Pairing,
W89-00424 5F

Programming Model for the Optimal Planning of Water Supply Systems,
W89-00452 6A

Upgrading Water Systems through Planning,
W89-00746 6B

Improving Canal Water Deliveries with Auxiliary Storage,
W89-00758 3B

Risk: A Key Water Policy Issue,
W89-01123 6D

Analytical Simulation of Water System Capacity Reliability: 1. Modified Frequency-Duration Analysis,
W89-01240 5F

Analytical Simulation of Water System Capacity Reliability: 2. A Markov Chain Approach and Verification of the Models,
W89-01241 5F

Water Supply Yields Power,
W89-01254 8C

WATER SUPPLY DEVELOPMENT

Water-Management Significance of the Moscow Canal,
W89-00050 3B

WATER SUPPLY SYSTEMS
London Water Ring Main,
W89-00840 5F

WATER TABLE FLUCTUATIONS
Shallowly Placed, Low Pressure Distribution System to Treat Domestic Wastewater in Soils with Fluctuating High Water Tables,
W89-01171 5D

WATER TEMPERATURE
Heat Balance of a Tidal Flat Area,
W89-00148 2L

Adaptation of Phytoplankton-Degrading Microbial Communities to Thermal Reactor Effluent in a New Cooling Reservoir,
W89-00336 5C

Effects of Temperature and Streamflow on Time and Duration of Spawning by Smallmouth Bass,
W89-00373 2H

Influence of an Arctic Large-Lakes System on Mesoclimate in South-Central Baffin Island, N.W.T., Canada,
W89-00437 2H

Effect of Salinity and Temperature Variations on the Bacterial Population in the Bot River Estuary,
W89-00657 2L

Satellite Observations of Tidal Upwelling and Mixing in the St. Lawrence Estuary,
W89-00834 2L

Interannual Variability in Climate and Fisheries in Tasmania,
W89-00847 2A

WATER TRANSFER
Do Water Market Prices Appropriately Measure Water Values,
W89-00837 6D

WATER TREATMENT
Systems Approach to Nitrate Removal from Groundwater Supplies,
W89-00134 5F

Limits of Growth of Five Chlorella Species in the Presence of Toxic Heavy Metals,
W89-00191 5C

Indicatory Role of Some Invertebrates for Quality of Water in the Vistula River and in Subsequent Stages of Its Treatment,
W89-00236 5A

Fate of Alachlor during Treatment of Public Water Supplies,
W89-00395 5F

Using Moringa Seeds as Coagulants in Developing Countries,
W89-00420 5F

Central Softening by Crystallization in a Fluidized-Bed Process,
W89-00421 5F

Development and Management of Groundwater Resources on Diego Garcia,
W89-00423 4B

Controlling Swampy Odors in Drinking Water,
W89-00425 5F

Trihalomethane Formation in High-Bromide Lake Galilee Water,
W89-00426 5F

Growth Kinetics of Hydroxide Flocs,
W89-00428 5F

Legionnaire's Disease in a Johannesburg Teaching Hospital,
W89-00450 5F

Binding and Removal of Aluminum Ions in Waters by an Algal Biomass.
W89-00478 5F

GAC Treatment Cost Experience at Two Drinking Water Utilities,
W89-00495 5F

Properties of Water Treatment Lime Sludges and Their Effectiveness as Agricultural Limestone Substitutes,
W89-00516 5F

Effect of Permanganate Oxidation and Chlorination on the Mutagenic Activity and other Quality Parameters of Artificially Recharged Ground Water Processed from Humus-rich Surface Water,
W89-00599 5F

Destruction of Polychlorinated Dibenzo-p-Dioxins and Dibenzofurans in Contaminated Water Samples Using Ozone,
W89-00606 5D

Investigation of the Production of Lipophilic Volatile Organohalogen Materials during Laboratory Chlorination of some Ground Water Samples from Yugoslavia,
W89-00608 5F

Chloropicrin in Potable Water: Conditions of Formation and Production during Treatment Processes (La Chloropicrine dans les Eaux Potables: Conditions de Formation et Evolution le long des Filieres de Traitement),
W89-00635 5F

Heavy Metal Removal by Different Water Treatment Plants, in Rio de Janeiro State, Brazil,
W89-00647 5F

Degradation of Polycyclic Aromatic Hydrocarbons: III. Reaction Products of the Ozonolysis of Further Polycyclic Aromatic Hydrocarbons in Aqueous Systems (Zum Abbau von Polycyclischen Aromatischen Kohlenwasserstoffen: III. Reaktionsprodukte der Umsetzung von Weiteren Polycyclischen Aromatischen Kohlenwasserstoffen in Wasser mit Ozon),
W89-00739 5F

Characterization of the Interaction Between Viruses and a Solid Polymeric Contact Disinfectant,
W89-00884 5F

Microporous Filters with Oxidizing Power for Iron and Manganese Removal from Water,
W89-00889 5F

Effect of Upgrading a Tubewell Water Supply in Rural Areas of Bangladesh,
W89-00920 5F

STASOFT: A User-Friendly Interactive Computer Program for Softening and Stabilisation of Municipal Waters,
W89-00935 5F

Treatment of Herbicides in Ground Water,
W89-00938 5F

Preliminary Plan for Membrane Desalination in China,
W89-01066 3A

Filtration Technologies for Water Treatment,
W89-01099 5F

Selecting a Contract Operator for Your Water or Wastewater Facility,
W89-01100 5F

Making the Right Moves in SCADA Selection,
W89-01103 5F

Radionuclides in Drinking Water,
W89-01104 5B

Occurrence of Radon in Well Supplies,
W89-01105 5B

Disposal of Radium Removed from Drinking Water,
W89-01106 5E

Operating a Small Full-Scale Ion Exchange System for Uranium Removal,
W89-01107 5F

Evaluating Various Adsorbents and Membranes for Removing Radium from Groundwater,
W89-01109 5F

Methods for Removing Uranium from Drinking Water,
W89-01110 5F

Role of the States in Solving the Small System Dilemma,
W89-01111 6E

SDWA Amendments: Small Community Compliance,
W89-01112 6E

Financing Strategies for Small Systems,
W89-01113 5F

AWWA Small Systems Program,
W89-01114 5F

Rural Community Assistance Program,
W89-01115 5F

Design Considerations for Package Water Treatment Systems,
W89-01117 5F

New Regulations: A Challenge for Small Systems,
W89-01118 5F

Ozone-Induced Particle Destabilization,
W89-01120 5F

Review of the Use of XAD Resins to Concentrate Organic Compounds in Water,
W89-01215 5A

Gravimetric Measurement of Adsorption Parameters in Water Systems with a Quartz Spring Balance,
W89-01216 5A

Factors Affecting Coagulation with Aluminum Sulfate: I. Particle Formation and Growth,
W89-01221 5F

Factors Affecting Coagulation with Aluminum Sulfate: II. Dissolved Organic Matter Removal,
W89-01222 5F

Mechanism of Inactivation of Tobacco Mosaic Virus with Ozone,
W89-01229 5F

Nitrate Removal from Water Supplies Using Biological Denitrification,
W89-01237 5F

WATER TREATMENT FACILITIES
Improving Water Supply in Thailand,
W89-00422 5F

Twinning: Utility Pairing,
W89-00424 5F

How Safe is Your Water Plant,
W89-00462 5F

GAC Treatment Cost Experience at Two Drinking Water Utilities,
W89-00495 5F

Package Water Treatment Facilities for Refugee Communities,
W89-00841 5F

Planning Indiana's Water Infrastructure from a Competitive Perspective,
W89-00880 6B

Empirical Correlation for Estimating Pressure Drop Across Clogged Filters,
W89-00924 5F

Filtration Technologies for Water Treatment,
W89-01099 5F

Design Considerations for Package Water Treatment Systems,
W89-01117 5F

WATER TREATMENT WASTES
Effects of Discharge Fluctuation and the Addition of Fine Sediment on Stream Fish and Macroinvertebrates Below a Water-Filtration Facility,
W89-01061 5C

WATER USE
Experiences With the Assessment of the Residual Water Flow in Regulated Water Courses in the Salzburg Region (Erfahrungen bei der Beurteilung der Restwasserfuhrung von Ausleitungsstrecken im Land Salzburg),
W89-00164 4A

Implications of Public Ownership of Irrigation Canal Systems in the Texas Rice Belt: Impacts on Water Use and Water Price,
W89-00460 6E

Historical Use of Ground Water in Terrell, Texas,
W89-00461 4B

Effects of Rate Structure Knowledge on Household Water Use,
W89-00877 6D

National Water Management in the Republic of South Africa: Towards a Consultative Partnership with Diverse Users in a Semi-Arid Country,
W89-01029 6D

Risk: A Key Water Policy Issue,
W89-01123 6D

WATER USE EFFICIENCY
Determination of Water Use Efficiency of Veld in the Central Orange Free State from Evapotranspiration Measurements (Bepaling van Waterverbruiksdoeltreffendheid van Veld in die Sentrale Oranje-Vrystaat Vanaf Evapotranspirasiemetings),
W89-00934 2D

WATER VAPOR
Theoretical Evaluation of Water Oligomer Populations in the Earth's Atmosphere,
W89-00763 2B

WATER YIELD
Water Resources, Salinity and Salt Yields of the Rivers of the Bolivian Amazon,
W89-01213 2E

Value of Stochastic Streamflow Models in Over-year Reservoir Design Applications,
W89-01244 2E

WATER YIELD FORECASTING
Prediction of Snowmelt Rates in a Deciduous Forest,
W89-01203 2C

WATER YIELD IMPROVEMENT
Improving Canal Water Deliveries with Auxiliary Storage,
W89-00758 3B

Enhancement of Runoff From a Small Watershed by Cloud Seeding,
W89-01212 3B

WATERFLEAS
Zooplankton Population of Man-Made Lakes in Abruzzi's Appennines: Campotosto Lake (Popolamento Zooplanctonico di un Lago di Sbarramento Dell'Appennino Abruzzese: Il Lago di Campotosto),
W89-00197 2H

Primary Studies on Population Dynamics of 3 Species of Cladocera (Waterflea) in Dianshan Lake, (in Chinese),
W89-00198 2H

WATERFOWL
Ecological Role of the Red-Knobbed Coot, Fulica cristata Gmelin, at the Bot River Estuary, South Africa: A Preliminary Investigation,
W89-00662 2L

WATERLOGGING
Spartina alterniflora Die-Back in Louisiana: Time-Course Investigation of Soil Waterlogging Effects,
W89-00286 2H

WATERPROOFING
Effective Coatings for Hydraulic Structures,
W89-00075 8G

WATERSHED MANAGEMENT
Sierra Club v. Block, Wilderness Water Rights Protected Where Not in Conflict with Purposes of National Forest in Colorado,
W89-00522 6E

Source Protection and the Small Utility,
W89-01116 5G

WATERSHED MODELS
Flow Simulation Using Channel Network Model,
W89-00751 7B

WATERSHEDS
Drainage Basin Control of Acid Loadings to Two Adirondack Lakes,
W89-00710 5B

Chemical-Hydrologic Interactions in the Near-Stream Zone,
W89-00717 2E

Fractal Nature of River Networks,
W89-00975 2E

WAVE DIRECTION
Measurement of Shallow Water Wave Direction for Longshore Sediment Transport,
W89-01082 2J

WEATHER
Evolution and Fine Structure of a Long-Lived Meso-alpha-Scale Convective System in a Baiu Frontal Zone. Part II: Meso-gamma-Scale Characteristics of Precipitation,
W89-00416 2B

Summer of 1987 in North-East England,
W89-00463 2B

54 Hours of Continuous Post-Frontal Precipitation North of the Alpine Mountain Barrier, 22-25 August 1975,
W89-00464 2B

WEATHER DATA COLLECTIONS
El Nino-Southern Oscillation and Rainfall Variability,
W89-00276 2B

Comparison of High-Altitude Remote Aircraft Measurements with the Radar Structure of an Oklahoma Thunderstorm: Implications for Precipitation Estimation from Space,
W89-00844 7B

Southwest Branch of the North American Monsoon During Summer 1979,
W89-00845 2A

Interannual Variability in Climate and Fisheries in Tasmania,
W89-00847 2A

Acidic Deposition Distribution and Episode Statistics from the MAP3S Network Database,
W89-01151 5B

WEATHER FORECASTING
Texas Drought History Reconstructed and Analyzed from 1698 to 1980,
W89-00273 2B

Predictability of Two Moisture Sources in the Namib Desert,
W89-00455 2B

Identification of Rainfall Type From Weather Radar Data,
W89-00842 2B

Model Output Statistics Forecasts: Three Years of Operational Experience in the Netherlands,
W89-00843 2B

Comparison of Model-Generated and Satellite-derived Cloud Cover and Radiation Budget,
W89-01262 2A

WEATHER MODIFICATION
Secondary Ice Nucleus Generation by Silver Iodide Applied to the Ground,
W89-00088 3B

Persistent Effects of Cloud Seeding with Silver Iodide,
W89-00091 3B

WEATHER PATTERNS
Summer of 1987 in North-East England,
W89-00463 2B

El Nino and Its Effect on Precipitation in Arizona and Western New Mexico,
W89-00474 2B

Mesoscale Spiral Vortex Embedded within a Lake Michigan Snow Squall Band: High Resolution Satellite Observations and Numerical Model Simulations,
W89-00748 2B

WEATHERING
Effects of Acidification on Metal Budgets of Lakes and Catchments,
W89-00207 5C

Role of Chemical Weathering in the Neutralization of Acidic Deposition,
W89-00696 5B

Surface Reactions of Synthetic, End-member Analogues of Monazite, Xenotime and Rhabdophane, and Evolution of Natural Waters,
W89-01080 2K

WEDDELL SEA
Nitrate Trace Determinations in Snow and Firn Core Samples of Ice Shelves at the Weddell Sea, Antarctica,
W89-01258 5B

WEIRS
Plunging and Streaming Flows in Pool and Weir Fishways,
W89-00904 2E

Generalized Rectangular Weir Equations,
W89-00905 8B

WELL LOGS
General Correction for Spontaneous Potential Well Logs in Fresh Water,
W89-01195 7B

WELL WATER
Determination of Fluoride Ion in Well Waters of Eastwood School District, Wood County, Ohio,
W89-00684 5A

Microbial Pollution of Well Water in Southeastern Minnesota,
W89-00887 5B

Effect of Upgrading a Tubewell Water Supply in Rural Areas of Bangladesh,
W89-00920 5F

Discrete Point Sampler for Ground Water Monitoring Wells,
W89-00947 7B

WELL WATERS
Operating a Small Full-Scale Ion Exchange System for Uranium Removal,
W89-01107 5F

WELLS
There's No Such Thing as a Representative Ground Water Sample,
W89-00937 5A

Screened Auger Sampling: The Technique and Two Case Studies,
W89-00945 5A

Contamination of Farmstead Wells by Pesticides, Volatile Organics, and Inorganic Chemicals in Kansas,
W89-00946 5B

Discrete Point Sampler for Ground Water Monitoring Wells,
W89-00947 7B

Occurrence of Radon in Well Supplies,
W89-01105 5B

WEST GERMANY
Chemical Methods of P-Elimination in the Tributaries of Reservoirs and Lakes,
W89-00020 5G

Water Catchment Installations Harmonized with Ecological Aspects - An Example in Berlin (West),
W89-00926 6B

WETLANDS
Pipe Flow in James Bay Coastal Wetlands,
W89-00047 2A

Biomass, Productivity and Life History Traits of Juncus militaris Bigel. in Two Rhode Island (U.S.A.) Freshwater Wetlands,
W89-00100 2H

Nitrogen Pools and Soil Characteristics of a Temperate Estuarine Wetland in Eastern Australia,
W89-00110 5B

Tropical Wetlands as a Carbon Source,
W89-00118 2H

Nutrient Dynamics in Minerotrophic Peat Mires,
W89-00119 2H

Role of Marsh Plants in the Transport of Nutrients as Shown by a Quantitative Model for the Freshwater Section of the Elbe Estuary,
W89-00120 2L

Peatland Soil-Plant Relationships in the New Forest,
W89-00122 2H

Use of Mires in Monitoring the Atmospheric Deposition of Heavy Metals,
W89-00123 5A

Patterns of Temperature and Humidity in Wetland Biotopes,
W89-00124 2H

Evapotranspiration of a Willow Carr in Summer,
W89-00125 2D

Seed Germination Traits of Annuals and Emergents Recruited during Drawdowns in the Delta Marsh, Manitoba, Canada,
W89-00126 2H

Microbiological Examination of the Carska Bara Swamp Water,
W89-00146 2H

Populations of Anaerobic Phototrophic Bacteria in a Spartina alterniflora Salt Marsh,
W89-00333 2L

Development of Streamlined Bog Islands in the Continental Interior of North America,
W89-00434 2H

Effectiveness of an Urban Runoff Detention Pond-Wetlands System,
W89-00487 5G

Typha Productivity in a Texas Pond: Implications for Energy and Nutrient Dynamics in Freshwater Wetlands,
W89-00524 2H

Variations in the Use of the Bot River Estuary by Water-Birds,
W89-00661 2L

Stream Chemistry in the New Jersey Pinelands: The Influence of Precipitation and Watershed Disturbance,
W89-00716 5B

Decomposition in an Ombrotrophic Bog and a Minerotrophic Fen in Minnesota,
W89-00742 2H

Evaluating Peat-Mining Hydrology Using DRAINMOD,
W89-00755 4C

Marsh Management Plans in Practice: Do They Work in Coastal Louisiana, USA,
W89-01060 2L

Once and Future Experience of the California Coastal Conservancy,
W89-01067 6E

Wetland Projects of the California State Coastal Conservancy: An Assessment,
W89-01069 6E

Restoration of Wetlands under Section 404 of the Clean Water Act: An Analytical Synthesis of Statutory and Case Law Principles,
W89-01189 6E

Runoff Generation in a Low Arctic Drainage Basin,
W89-01207 2A

WHALES
Regulation of the River Dee,
W89-00953 4A

WILDERNESS AREAS
Sierra Club v. Block, Wilderness Water Rights Protected Where Not in Conflict with Purposes of National Forest in Colorado,
W89-00522 6E

WILLAMETTE RIVER
Longitudinal Changes in Fish Assemblages and Water Quality in the Willamette River, Oregon,
W89-00029 2H

WILLOW TREES
Evapotranspiration of a Willow Carr in Summer,
W89-00125 2D

WIND
Experimental Marvin Windshield Effects on Precipitation Records in Leadville, Colorado,
W89-00876 7B

WIND-DRIVEN CURRENTS
Numerical Model for the Wind-Driven Circulation in the Bot River Estuary,
W89-00652 2L

WIND ENERGY
Future Prospects for Hydro Electricity and Windpower,
W89-00793 6C

WIND EROSION
Stokes Surfaces and the Effects of Near-Surface Groundwater-Table on Aeolian Deposition,
W89-00410 2J

WIND WAVES
Numerical Model for the Wind-Driven Circulation in the Bot River Estuary,
W89-00652 2L

WITOBELSKIE LAKE
Effect of Witobelskie and Lodzko-Dymaczewskie Lakes on Phytoplankton of Samica Steszewska River,
W89-00247 2H

WOUNDFIN
Endangered Woundfin and Water Management in the Virgin River, Utah, Arizona, Nevada,
W89-00311 6G

WRONKI LAKE
Differentiation of the Physical and Chemical Properties of Bottom Sediments in Phytocenoses of Myriophylletum verticillati Soo 1927, Potamogetonetum natantis Soo 1927 and Hydrocharitetum morsus-ranae Langendonck 1935 Associations,
W89-00259 2H

X-RAYS
Compressible Cake Filtration: Monitoring Cake Formation and Shrinkage Using Synchrotron X-rays,
W89-00512 5D

XAD RESINS
Review of the Use of XAD Resins to Concentrate Organic Compounds in Water,
W89-01215 5A

XENOBIOTICS
Aerobic Biodegradation of Natural and Xenobiotic Organic Compounds By Subsurface Microbial Communities,
W89-01090 5B

YAMUNA RIVER
Complex Geology Leads to an Unusual Design for the Lakhwar Dam,
W89-01005 8E

YANGTZE RIVER
Dongjiang: A 500 MW Hydro Plant for Hunan Province,
W89-01001 8C

YELLOW CRABS
Acute Toxicities of Eleven Metals to Early Life-History Stages of the Yellow Crab Cancer anthonyi,
W89-00386 5C

YUGOSLAVIA
Microbiological Examination of the Carska Bara Swamp Water,
W89-00146 2H

Some Hydrochemical, Hydrobiological, and Ichthyological Features of Yugoslav Part of the Danube Lasting for Several Years (Einige hydrochemische, hydrobiologische und ichthyologische Eigenschaften der jugoslawischen Donaustrecke in mehrjahrigem Zeitraum),
W89-00165 5C

Principal Component Analysis of Precipitation in the Adriatic-Pannonian Area of Yugoslavia,
W89-00472 2B

Polychlorinated Biphenyls in the Kupa River, Croatia, Yugoslavia,
W89-00609 5B

ZHUJIANG ESTUARY

Distribution of Agglutinated Foraminifera in Bottom Sediments of the Zhujiang River Estuary, (in Chinese),
W89-00203 2L

ZOOPLANKTON

Seasonal and Short-Term Fluctuations in the Zooplankton Community of Paranoa Reservoir, Brasilia, Federal District, Brazil (Flutuacoes Sazonais e de Curta Duracao na Comunidade Zooplanktonica do Lago Paranoa, Brasilia-DF, Brasil),
W89-00006 2H

Drift of Zooplankton in a Lake-Outlet (Glatt) in a Day-Night-Rhythm Depending from the Water Level,
W89-00025 2H

Relationship between Zooplankton Development and Environmental Conditions in Different Types of Lakes in the Zone of Temperate Climate.
W89-00138 2H

Some Hydrochemical, Hydrobiological, and Ichthyological Features of Yugoslav Part of the Danube Lasting for Several Years (Einige hydrochemische, hydrobiologische und ichthyologische Eigenschaften der jugoslawischen Donaustrecke in mehrjahrigem Zeitraum),
W89-00165 5C

Impact of Impounding on the Oxygen Balance of the Danube from Kelheim to Jochenstein Microbiological-Biochemical Investigations and Water Quality Model Calculations (Zum Einfluss der Strauregulierung auf den Sauerstoffhaushalt der Donaustrecke Kelheim-Jochenstein: Mikrobiologisch-biochemische Untersuchungen und Gutemodellrechnungen),
W89-00173 6G

Community Grazing and the Regulation of In Situ Clearance and Feeding Rates of Planktonic Crustaceans in Lakes in the Kuokkel Area, Northern Sweden,
W89-00181 2H

Zooplankton Population of Man-Made Lakes in Abruzzi's Appennines: Campotosto Lake (Popolamento Zooplanctonico di un Lago di Sbarramento Dell'Appennino Abruzzese: Il Lago di Campotosto),
W89-00197 2H

Body Size and Mass Flow in Freshwater Plankton: Models and Tests,
W89-00218 2H

Zooplankton Community Grazing in a Hypertrophic Lake (Hartbeespoort Dam, South Africa),
W89-00220 2H

Tidal Transport of Planktonic Copepods across the Sill of a British Columbia Fjord,
W89-00221 2L

Tintinnids and Other Microzooplankton - Seasonal Distributions and Relationships to Resources and Hydrography in a Maine Estuary,
W89-00223 2L

Short-Term Variations in the Zooplankton Community Related to Water Exchange Processes in the Gullmar Fjord, Sweden,
W89-00228 2H

Feeding and Swimming Behavior in Grazing Microzooplankton,
W89-00382 2H

Dynamics of Protistan Carbon and Nutrient Cycling,
W89-00383 2L

Zooplankton and Some Environmental Conditions in the Bot River Estuary,
W89-00659 2L

Hydrography and Plankton of the Moray Firth,
W89-00778 2L

Zooplankton Investigations in the Firth of Clyde,
W89-00814 2L

Large-Scale and Long-Term Variations in the Zooplankton Community of the Gullmar Fjord, Sweden, in Relation to Advective Processes,
W89-01038 2L

Interspecific, Seasonal and Diel Variations in Zooplankton Trypsin and Amylase Activities in Kosterfjorden, Western Sweden,
W89-01040 2L

Discrimination between Algae and Artificial Particles by Freshwater and Marine Copepods,
W89-01047 2H

Size Structure of Planktonic Crustaceans in a Dimictic Lake on the Canadian Shield (Structure en Taille des Crustaces Planctoniques d'un Lac Dimictique du Bouclier Canadien),
W89-01231 2H

Community Structure of Zooplankton in Eastern Hudson Bay,
W89-01232 2L

AUTHOR INDEX

ABARZUA, A. S.
Effect of 3,4 Benzopyrene on the Photosynthetic and Respiratory Intensity of the Green Alga Scenedesmus quadricauda (Der Einfluss von 3,4-Benzpyren aud die Photosynthese- une Respirationsintensitat der Gruenalge Scenedesmus quadricauda),
W89-00135 5C

ABBAS, M. N.
Determination of Traces of Bismuth in Water with Polyurethane Foam Thin-Layer Spectrophotometry,
W89-00482 5A

ABDEL-SHAFY, H. I.
Studies on the Degradation of Synthetic Detergents by Sewage,
W89-01159 5B

ABDERRAHMAN, W. A.
Flow Simulation Using Channel Network Model,
W89-00751 7B

ABDUL, A. S.
Statistical Correlations for Predicting the Partition Coefficient for Nonpolar Organic Contaminants Between Aquifer Organic Carbon and Water,
W89-00992 5B

ABERNATHY, A. R.
Method to Assess Periodic Responses of Aquatic Microecosystems to Photosynthetic Inhibition,
W89-00562 7B

ABERNETHY, S. G.
Volume Fraction Correlation for Narcosis in Aquatic Organisms: The Key Role of Partitioning,
W89-01096 5C

ABO-ELELA, S. I.
Treatability Studies of Textile Wastewater,
W89-00627 5D

ACKERS, P.
Alluvial Channel Hydraulics,
W89-01017 2J

ADAMOWICZ, W. L.
Ex Post Analysis of Flood Control: Benefit-Cost Analysis and the Value of Information,
W89-00983 6C

ADAMS, J. A.
Hydrography and Plankton of the Moray Firth,
W89-00778 2L

Zooplankton Investigations in the Firth of Clyde,
W89-00814 2L

ADAMS, J. Q.
GAC Treatment Cost Experience at Two Drinking Water Utilities,
W89-00495 5F

ADAMS, J. R.
Long-Term Ecological Research on Illinois Rivers,
W89-00401 2H

ADAMS, M.
Prospects for Transfer of the California Coastal Conservancy Model for Habitat Restoration to Other Coastal States,
W89-01070 6E

ADAMS, M. S.
Effects of Light and Temperature on Photosynthesis of the Nuisance Alga Cladophora glomerata (L.) Kutz from Green Bay, Lake Michigan,
W89-00848 2H

AELION, C. M.
Aerobic Biodegradation of Natural and Xenobiotic Organic Compounds By Subsurface Microbial Communities,
W89-01090 5B

AGELIDIS, T.
Comparative Study of Heavy Metals Pollution in Various Rivers and Lakes of Northern Greece,
W89-00571 5B

AGNESE, C.
Estimation of the Time Scale of the Geomorphologic Instantaneous Unit Hydrograph from Effective Streamflow Velocity,
W89-00704 2E

AGRAWAL, C. K.
Complex Geology Leads to an Unusual Design for the Lakhwar Dam,
W89-01005 8E

AGTHE, D. E.
Effects of Rate Structure Knowledge on Household Water Use,
W89-00877 6D

AGUIAR, A. L. C.
Liquid Effluents of the Fish Canning Industries of Rio de Janeiro State: Treatment Alternatives,
W89-00646 5D

AGUILAR, C.
Manganese Oxidation in pH and O2 Microenvironments Produced by Phytoplankton,
W89-01045 2K

AGUILAR FLORES, A.
Mercury in Freshwater Fish and Clams from the Cerro Prieto Geothermal Field of Baja California, Mexico,
W89-01153 5B

AGURSKY, T.
Association Between Seawater Pollution as Measured by Bacterial Indicators and Morbidity Among Bathers at Mediterranean Bathing Beaches of Israel,
W89-00579 5C

AHLERT, R. C.
Design Criteria for In-Situ and On-Site Renovation of an Industrial Sludge Lagoon,
W89-00996 5B

AHMAD, M. I.
Assessment of Flood Frequency Models Using Empirical Distribution Function Statistics,
W89-00976 2E

Location-Invariant Plotting Positions for PWM Estimation of the Parameters of the GEV Distribution,
W89-00351 2E

AHMED, F.
Effect of Upgrading a Tubewell Water Supply in Rural Areas of Bangladesh,
W89-00920 5F

AHUJA, L. R.
Effect of Assumed Unit Gradient During Drainage on the Determination of Unsaturated Hydraulic Conductivity and Infiltration Parameters,
W89-00407 2G

Vertical Variability of Soil Properties in a Small Watershed,
W89-00354 2G

AIKEN, J. D.
New Directions in Nebraska Water Policy,
W89-01266 6E

AKIYAMA, T.
Evolution and Fine Structure of a Long-Lived Meso-alpha-Scale Convective System in a Baiu Frontal Zone. Part II: Meso-gamma-Scale Characteristics of Precipitation,
W89-00416 2B

AL-DARBY, A. M.
Horizontal Infiltration of Water in Soil Columns as Affected by a Gel-Forming Conditioner,
W89-00741 2G

AL-JAFARY, A. R.
Some Biological Aspects of Liza abu (Heckel) mugilidae, in AL-Daoodi Drain, (Baghdad, Iraq),
W89-00890 2H

AL-OMRAN, A. M.
Horizontal Infiltration of Water in Soil Columns as Affected by a Gel-Forming Conditioner,
W89-00741 2G

AL-RAMADHAN, B. M.
Residual Fluxes of Water in an Estuarine Lagoon,
W89-00142 2L

AL-YAMOUR, K. Y.
Some Biological Aspects of Liza abu (Heckel) mugilidae, in AL-Daoodi Drain, (Baghdad, Iraq),
W89-00890 2H

ALA-PEIJARI, T.
Effect of Permanganate Oxidation and Chlorination on the Mutagenic Activity and other Quality Parameters of Artificially Recharged Ground Water Processed from Humus-rich Surface Water,
W89-00599 5F

ALBERTS, J. J.
Effect of pH and Contact Time on the Concentration of As(III) and As(V) in Coal Ash Systems,
W89-00624 5E

ALEXANDER, R.
Controlling Swampy Odors in Drinking Water,
W89-00425 5F

ALEXANDER, R. B.
Trends in Lead Concentrations in Major U.S. Rivers and Their Relation to Historical Changes in Gasoline-Lead Consumption,
W89-00868 5B

ALGEO, D. J.
Use of Network Analysis Techniques in the Development and Optimization of a large UK Urban Water Distribution System (L'Emploi de Techniques),
W89-00918 5F

ALHAJJAR, B. J.
Transport Modelling of Biological Tracers from Septic Systems,
W89-01226 5B

ALI, H. I.
Treatability Studies of Textile Wastewater,
W89-00627 5D

ALIEV, E. V.
Introduction of New Technology on the Construction of the Shamkhor Hydroelectric Station,
W89-00039 8A

ALKHATIB, E. A.
In situ Adapation of Activated Sludge by Shock Loading to Enhance Treatment of High Ammonia Content Petrochemical Wastewater,
W89-01127 5D

ALLANSON, B. R.
Flux of Organic Carbon in a Tidal Salt Marsh, Kowie River Estuary, Port Alfred, South Africa,
W89-00453 2L

ALLARD, A. S.
Environmental Fate of Chloroguaiacols and Chlorocatechols,
W89-00369 5B

ALLEMAN, B. C.
Biosorption of Organic Halide in a Kraft Mill Generated Lagoon,
W89-01138 5D

ALLEN, M. J.
National Field Evaluation of a Defined Substrate Method for the Simultaneous Enumeration of Total Coliforms and Escherichia coli from Drinking Water: Comparison with the Standard Multiple Tube Fermentation Method,
W89-00337 5A

ALLEN, R. H.
Peatland Soil-Plant Relationships in the New Forest,
W89-00122 2H

ALLEN, S. J.
Multi-Component Sorption Isotherms of Basic Dyes onto Peat,
W89-00083 5D

ALLISON, G. B.
Tracing of Water Movement in the Unsaturated Zone Using Stable Isotopes of Hydrogen and Oxygen,
W89-01016 2G

ALLISON, R. C.
Risk: A Key Water Policy Issue,
W89-01123 6D

ALLOUSE, S. B.
Some Biological Aspects of Liza abu (Heckel) mugilidae, in AL-Daoodi Drain, (Baghdad, Iraq),
W89-00890 2H

ALONGI, D. M.
Microbial-Meiofaunal Interrelationships in Some Tropical Intertidal Sediments,
W89-00766 2L

ALSBERG, T.
Analysis of Halogenated Polycyclic Aromatic Hydrocarbons in Urban Air, Snow and Automobile Exhaust,
W89-00613 5B

ALTUNINA, G. S.
Capacity of Ice-Covered Canals,
W89-01177 8B

ALVES, L. F.
Nitrate and Ammonium Uptake by Plankton in an Amazon River Floodplain Lake,
W89-00229 2H

AMBROSE, R. B.
Waste Allocation Simulation Models,
W89-01234 5D

AMSPOKER, M. C.
Effects of Sediment Properties on Benthic Primary Production in the Columbia River Estuary,
W89-00115 2L

AMUNDSON, D.
Microbial Pollution of Well Water in Southeastern Minnesota,
W89-00887 5B

AMY, G. L.
Biosorption of Organic Halide in a Kraft Mill Generated Lagoon,
W89-01138 5D

Factors Affecting Coagulation with Aluminum Sulfate: I. Particle Formation and Growth,
W89-01221 5F

Factors Affecting Coagulation with Aluminum Sulfate: II. Dissolved Organic Matter Removal,
W89-01222 5F

ANDERSEN, K.
Effect of Light Regime upon Growth Rate and Chemical Composition of a Clone of Skeletonema costatum from the Trondheimsfjord, Norway,
W89-00212 2L

ANDERSEN, V.
Pelagic Ecosystem Model Simulating Production and Sedimentation of Biogenic Particles: Role of Salps and Copepods,
W89-01041 2L

ANDERSON, C.
Studies of the Oxidative Photoinduced Degradation of Silicones in the Aquatic Environment,
W89-00617 5B

ANDERSON, R. V.
Long-Term Ecological Research on Illinois Rivers,
W89-00401 2H

ANDERSSON, T.
Physiological Disturbances in Fish Exposed to Bleached Kraft Mill Effluents,
W89-00363 5C

ANDO, M.
Inhabitants' Life in the Lowland of the Kiso, Nagara and Ibi Rivers, (in Japanese),
W89-00205 4A

ANDRADE, E. R.
El Nino and Its Effect on Precipitation in Arizona and Western New Mexico,
W89-00474 2B

ANDREEV, A. E.
Size of the Concrete Part of a Combined Apron below Low-head Outlet Works,
W89-01175 8B

ANDREEV, V. G.
Experience in Determining the Numerical Characteristics of Landslide Movements,
W89-00551 8A

ANDRESEN, S.
Sea Use Planning in Norwegian Waters: National and International Dimensions,
W89-00289 6E

ANGERMEIER, P. L.
Effects of Season and Substrate on Availability of Drift for Fish in a Small Warmwater Stream,
W89-00400 2H

ANLAUF, K. G.
Winter Cloud Water and Air Composition in Central Ontario,
W89-01265 5C

ANSELL, A. D.
Benthos of the Deeper Sediments of the Firth of Clyde, with Particular Reference to Organic Enrichment,
W89-00820 5C

ANTRIM, L.
Sea-Surface Microlayer of Puget Sound: Part I: Toxic Effects on Fish Eggs and Larvae,
W89-00853 5C

ANTRIM, L. D.
Contaminant Concentrations and Toxicity of Sea-Surface Microlayer Near Los Angeles, California,
W89-00857 5C

Sea-Surface Microlayer of Puget Sound: Part II: Concentrations of Contaminants and Relation to Toxicity,
W89-00854 5C

ANTROPOVSKII, V. I.
Calculation of Channel Deformations of Large Earth Canals with Damless Water Intake from Reservoirs,
W89-00553 8A

APOSTOLOPOULOU, A.
Correlation of Some Organic Pollution Factors in Water Systems in Northern Greece,
W89-00566 5B

APRAIZ, D.
Epidemiological Study of the Legionella pneumophila Presence in Potable Water in Alicante,
W89-00925 5A

APTE, S. C.
Determination of Organotins in Natural Waters by Toluene Extraction and Graphite Furnace AAS,
W89-00743 5A

APTS, C. W.
Sea-Surface Microlayer of Puget Sound: Part II: Concentrations of Contaminants and Relation to Toxicity,
W89-00854 5C

ARAFAT, N.
Use of Mires in Monitoring the Atmospheric Deposition of Heavy Metals,
W89-00123 5A

ARANUVACHAPUN, S.
Landsat-MSS Radiance as a Measure of Suspended Sediment in the Lower Yellow River (Hwang Ho),
W89-00065 7B

ARCHIBALD, C. G. M.
Simple and Efficient New Design of the Submersible Stirrer for the YSI Dissolved Oxygen Meter,
W89-00936 7B

ARCIFA, M. S.
Fish Communities in Reservoirs in Southern Brazil (Comunidades de Peixes de Reservatorios no Sul do Brasil),
W89-00011 2H

ARIFIN, R.
Sewage Sludge-Soil Interactions as Measured by Plant and Soil Chemical Composition,
W89-01161 5E

ARIKAN, A.
MODALP: A Deterministic Rainfall-Runoff Model for Large Karstic Areas,
W89-01145 2F

ARKELL, B. P.
Stream Nitrate Levels in a Small Catchment in South West England Over a Period of 15 Years (1970 - 1985),
W89-00915 5B

ARMONIES, W.
Active Emergence of Meiofauna from Intertidal Sediment,
W89-01037 2L

ARNDT, D. J.
Making the Right Moves in SCADA Selection,
W89-01103 5F

ARNDT, H.
Effect of 3,4 Benzopyrene on the Photosynthetic and Respiratory Intensity of the Green Alga Scenedesmus quadricauda (Der Einfluss von 3,4-Benzpyren aud die Photosynthese- une Respirationsintensitat der Gruenalge Scenedesmus quadricauda),
W89-00135 5C

ARNOLD, L. M.
Induced Resistance to Polychlorinated Biphenyls Confers Cross-Resistance and Altered Environmental Fitness in a Marine Diatom,
W89-00860 5C

ARORA, B. M.
Complex Geology Leads to an Unusual Design for the Lakhwar Dam,
W89-01005 8E

ARSHENEVSKII, N. N.
Reconstruction of the Surge Tank of the Sengilei Hydroelectric Station,
W89-00546 8C

ARTHUR, A.
Epilithic Diatoms of the Clyde Estuary,
W89-00808 2L

ARTZ, R. S.
Occurrence and Distribution of Trace Organic Compounds in Bermuda Precipitation,
W89-01148 5B

ARVANITOYANNIS, I.
Treatment of Dye-Containing Effluents with Different Bentonites,
W89-00615 5D

ASHENDEN, T. W.
Differences in the Spectral Characteristics of Birch Canopies Exposed to Simulated Acid Rain,
W89-00849 5C

ASHIKHMEN, V. A.
Characteristics of the Organization and Performance of Works in the Dam Foundation of the Al-Hadithah Hydro Development (Iraq),
W89-01182 8F

ASHKAR, F.
Confidence Intervals for Flood Events Under a Pearson 3 or Log Pearson 3 Distribution,
W89-00879 7C

Generalized Method of Moments Applied to LP3 Distribution,
W89-00901 2E

ATHANASOPOULOS, N.
Cotton Yarn and Fabric Finishing Wastewater Treatment in Upflow Anaerobic Filter,
W89-00277 5D

ATKINSON, R. J. A.
Mud-Burrowing Megafauna of the Clyde Sea Area,
W89-00821 2L

AUALIITIA, T. U.
Sediment Analysis: Lability of Selectively Extracted Fractions,
W89-00744 5A

AUSTERN, B. M.
Removal of Organic Toxic Pollutants by Trickling Filter and Activated Sludge,
W89-01133 5D

AUSTIN, M. P.
Landscape and Rainfall Indices for Prediction of Streamflow Similarities in the Hunter Valley, Australia,
W89-00972 2E

AUTIO, S.
Leaching of Mercury from Peat Soil,
W89-00592 5B

AYALA, F.
Animal Wastes Media for Spirulina Production,
W89-00136 5D

AZCUE, P.
Heavy Metal Removal by Different Water Treatment Plants, in Rio de Janeiro State, Brazil,
W89-00647 5F

AZZAM, A. M.
Studies on the Degradation of Synthetic Detergents by Sewage,
W89-01159 5B

BACHMANN, H.
Hydrodynamic-Stiffness Matrix Based on Boundary Elements for Time-Domain Dam-Reservoir-Soil Analysis,
W89-00447 8B

BAGNATI, R.
Analysis of Atrazine in Underground Waters at Part Per Trillion Levels as an Early Warning Method for Contamination and for Soil Distribution Studies,
W89-00596 5A

BAGWELL, D. A.
Hazardous and Noxious Substances,
W89-00519 5G

BAICHENG, Z.
Extraction and Determination of Chlorophyll from Benthic Green Algae with Dimethyl Sulfoxide, (in Chinese),
W89-00539 7B

BAILEY, R. S.
Biology and Management of Herring and Other Pelagic Fish Stocks in the Firth of Clyde,
W89-00825 2L

BAIN, M. B.
Streamflow Regulation and Fish Community Structure,
W89-01053 4A

BAJKIEWICZ-GRABOWSKA, E.
Natural Degradation Ability of Lakes and the Role of Drainage Area in the Process (Ocena naturalnej podatnosci jezior na degradacje i rola zlewni u tym procesie),
W89-00032 2H

BAKER, J. H.
Feeding of a Freshwater Flagellate, Bodo saltans, on Diverse Bacteria,
W89-00381 2H

BAKER, L. A.
Alkalinity Regulation in Softwater Florida Lakes,
W89-00714 2H

BAKO, M. D.
Derivation of Baseflow Recession Constant Using Computer and Numerical Analysis,
W89-01142 2E

BAKTHAVATHSALAM, R.
Effects of Lindane and Atropine Sulphate on the Tissues of the Fish, Anabas testudineus (Bloch): A Chronotoxicological Approach,
W89-00594 5C

BALASUBRAMANIAN, U.
Effects of Lindane and Atropine Sulphate on the Tissues of the Fish, Anabas testudineus (Bloch): A Chronotoxicological Approach,
W89-00594 5C

BALE, A. J.
Nitrite and Ammonia in the Tamar Estuary,
W89-00154 5B

BALLY, R.
Benthic Macrofauna of the Bot River Estuary, South Africa, with a Note on Its Meiofauna,
W89-00660 2L

Ecological Role of the Red-Knobbed Coot, Fulica cristata Gmelin, at the Bot River Estuary, South Africa: A Preliminary Investigation,
W89-00662 2L

Historical Records of the Bot River Estuarine System,
W89-00653 2L

Physical and Chemical Characteristics of the Waters of the Bot River Estuary, South Africa,
W89-00655 2L

Primary Productivity of the Bot River Estuary, South Africa,
W89-00656 2L

Synopsis of the Impact of Artificially Opening the Mouth of the Bot River Estuary: Implications for Management,
W89-00666 2L

BALTENSPERGER, U.
Determination of Mono- and Divalent Cations and Anions in Small Fog Samples by Ion Chromatography,
W89-00372 5A

BALTZ, D. M.
Influence of Temperature on Microhabitat Choice by Fishes in a California Stream,
W89-00027 2H

Microhabitat Use by an Assemblage of California Stream Fishes: Developing Criteria for Instream Flow Determinations,
W89-00319 6D

BAMSTEDT, U.
Interspecific, Seasonal and Diel Variations in Zooplankton Trypsin and Amylase Activities in Kosterfjorden, Western Sweden,
W89-01040 2L

BANCROFT, G. M.
Surface Reactions of Synthetic, End-member Analogues of Monazite, Xenotime and Rhabdophane, and Evolution of Natural Waters,
W89-01080 2K

BANSE, K.
Clouds, Deep Chlorophyll Maxima and the Nutrient Supply to the Mixed Layer of Stratified Water Bodies,
W89-00227 2L

BARBANTI, A.
Sequential Extraction of Phosphorus and Heavy Metals from Sediments: Methodological Considerations,
W89-00629 5A

BARBOSA, F. A. R.
Decomposition Rates of Allochthonous Material (Litter) in Lake Carioca - Rio Doce Forest Park - MG (Taxa de Decomposicao do Material Aloctone 'Litter' na Lagoa Carioca - Parque Florestal do Rio Doce - Minas Gerias),
W89-00007 2H

BARBOUR, S. L.
Modelling of Flow Through Potash Tailings Piles,
W89-00388 5B

BARCELONA, M. J.
Oxygen Transfer Through Flexible Tubing and Its Effects on Ground Water Sampling Results,
W89-00943 5A

BARI, A.
High Level Disinfection of Wastewaters for Reuse,
W89-00642 5D

BARKLEY, W. A.
Biosorption of Organic Halide in a Kraft Mill Generated Lagoon,
W89-01138 5D

BARNES, B. B.
Effect of Assumed Unit Gradient During Drainage on the Determination of Unsaturated Hydraulic Conductivity and Infiltration Parameters,
W89-00407 2G

BARNES, C. J.
Tracing of Water Movement in the Unsaturated Zone Using Stable Isotopes of Hydrogen and Oxygen,
W89-01016 2G

BARNES, R. S. K.
Faunas of Land-Locked Lagoons: Chance Differences and the Problems of Dispersal,
W89-00141 2L

BARNETT, P. R. O.
Biology of Harpacticoid Copepods in the Meiofauna of Shallow Subtidal Sands,
W89-00818 2L

Long-Term Changes in Some Benthic Species in the Firth of Clyde, with Particular Reference to Tellina tenuis da Costa,
W89-00817 5C

BARNWELL, T. O.
Waste Allocation Simulation Models,
W89-01234 5D

BARRIE, L. A.
Aspects of Atmospheric Pollutant Origin and Deposition Revealed by Multielemental Observations at a Rural Location in Eastern Canada,
W89-01264 5B

BARRING, L.
Regionalization of Daily Rainfall in Kenya by Means of Common Factor Analysis,
W89-00473 2B

BARTHA, R.
Immobilization of Leachable Toxic Soil Pollutants by Using Oxidative Enzymes,
W89-00341 5G

BASU, D. K.
Comparison of Drinking Water Mutagenicity with Leaching of Polycyclic Aromatic Hydrocarbons from Water Distribution Pipes,
W89-00619 5C

BATE, G. C.
Spatial Patterns of N Fixation (Acetylene Reduction) along Environmental Gradients in a Warm-Temperate Estuary,
W89-00475 2L

BATES, N. M.
Effect of pH and Total Ion Concentration on Growth Rate of Chironomus nr. maturus Larvae (Diptera: Chironomidae) from an Acid Strip-Mine Lake,
W89-00399 5C

BATESON, M. M.
Photoexcretion and Fate of Glycolate in a Hot Spring Cyanobacterial Mat,
W89-00342 2H

BATH, A. H.
Stable Isotope Study of Recharge Processes in the English Chalk,
W89-01197 2F

BATT, S.
Pollution Control and Environmental Planning for the Beatrice Oilfield and Nigg Oil Terminal,
W89-00788 5G

BATTERMAN, A. R.
Bioavailability of Polychlorinated Dibenzo-p-dioxins and Dibenzofurans from Contaminated Wisconsin River Sediment to Carp,
W89-00583 5B

BAUER, J. E.
Effects of Co-Occurring Aromatic Hydrocarbons on Degradation of Individual Polycyclic Aromatic Hydrocarbons in Marine Sediment Slurries,
W89-00339 5B

BAUMANN, P. C.
Tumor Frequencies and Contaminant Concentrations in Brown Bullheads from an Industrialized River and a Recreational Lake,
W89-00028 5C

BAUMANN, R. A.
Determination of Polychlorinated Dibenzofurans in Surface Water by Means of Liquid Chromatography Using on-Line Sample Preconcentration and Different Spectroscopic Detection Techniques,
W89-00590 5A

BAUTISTA, M. F.
PCB-resistant Diatoms in the Hudson River Estuary,
W89-00284 5C

BAXTER, M. S.
Clyde Sea Hydrography,
W89-00802 2L

BAZZANTI, M.
Seasonal Changes of the Profundal Macrobenthic Community in a Polluted Lake,
W89-00693 5C

BEAR, J.
Continuum Models for Contaminant Transport in Fractured Porous Formations,
W89-00966 5B

BECK, M. B.
Dynamic Modeling of Primary Sedimentation,
W89-00483 5D

BECKER, D. S.
Hepatic Lesions in English Sole (Parophrys vetulus) from Commencement Bay, Washington (USA),
W89-00859 5C

BECKETT, P. H. T.
Soil Solution in a Soil Treated with Digested Sewage Sludge,
W89-00413 5B

BEDARD, J.
Factors Influencing Aboveground Production of Scirpus Marshes in the St. Lawrence Estuary, Quebec, Canada,
W89-00529 2L

BEDFORD, K. W.
Determinations of Suspended Sediment Concentrations from Multiple Day Landsat and AVHRR Data,
W89-00064 7B

BEDFORD, W. K.
Removal of Pentachlorophenol in Municipal Activated Sludge Systems,
W89-00509 5D

BEDNARZ, T.
Development of Microorganisms on the Background of Organic Matter in Forest Ecosystem Waters,
W89-00080 2H

BEESE, B.
Seasonal Productivity Cycle of Phytoplankton and Controlling Factors in Lake Constance,
W89-00022 2H

BEIM, G. K.
Analytical Simulation of Water System Capacity Reliability: 1. Modified Frequency-Duration Analysis,
W89-01240 5F

Analytical Simulation of Water System Capacity Reliability: 2. A Markov Chain Approach and Verification of the Models,
W89-01241 5F

BELLIYAPPA, G.
Growth and Conversion Efficiency of the Catfish Heteropneustes fossilis (Bloch) Exposed to Sub-Lethal Concentrations of Sodium Pentachlorophenate,
W89-00243 5C

BELTRAME, C.
Micronucleus Test: Examples of Application to Marine Ecology,
W89-01042 5A

BELYAKOV, Y. P.
New Life for Small Hydroelectric Stations in Kirgizia,
W89-00042 8C

BEN-ZVI, A.
Enhancement of Runoff From a Small Watershed by Cloud Seeding,
W89-01212 3B

BENDA, A.
Comparison of Three Sediment Bioassay Methods Using Detroit River Sediments,
W89-01097 5A

BENEFIELD, L. D.
Activated Sludge Systems with Biomass Particle Support Structures,
W89-01256 5D

Numerical Transport Model for Oxygen- and Nitrate-Based Respiration Linked to Substrate and Nutrient Availability in Porous Media,
W89-01251 5D

BENFENATI, E.
Analysis of Atrazine in Underground Waters at Part Per Trillion Levels as an Early Warning Method for Contamination and for Soil Distribution Studies,
W89-00596 5A

BENGSTON, H. H.
MCRT for Control of Cokemaking Wastewater treatment,
W89-01139 5D

BENGTSSON, B. E.
Effects of Pulp Mill Effluents on Skeletal Parameters in Fish: A Progress Report,
W89-00365 5C

Investigations of Chlorinated Thiophenes: A Group of Bioaccumulable Compounds Identified in the Effluents from Kraft Bleaching,
W89-00360 5B

BENJAMIN, M. M.
Effects of Cyanide and Polyphosphates on Adsorption of Metals from Simulated and Real Mixed-Metal Plating Wastes,
W89-01219 5D

BENNDORF, J.
Food Web Manipulation Without Nutrient Control: A Useful Strategy in Lake Restoration,
W89-00019 5G

BENNER, R.
Adaptation of Phytoplankton-Degrading Microbial Communities to Thermal Reactor Effluent in a New Cooling Reservoir,
W89-00336 5C

BENNETT, B. A.
Changes in the Fish Fauna of the Bot River Estuary in Relation to Opening and Closure of the Estuary Mouth,
W89-00665 2L

Comparison of the Physiological Condition of the Southern Mullet Liza richardsoni (Smith), in a Closed Estuary and the Sea,
W89-00663 2L

Mass Mortality of Fish Associated with Low Salinity Conditions in the Bot River Estuary,
W89-00664 2L

Synopsis of the Impact of Artificially Opening the Mouth of the Bot River Estuary: Implications for Management,
W89-00666 2L

BENNETT, W. N.
Assessment of Selenium Toxicity in Algae Using Turbidostat Culture,
W89-01230 5C

BENSON, A.
Effect of Low pH on Survival of Brook Trout Embryos and Yolk-Sac Larvae in West Virginia Streams,
W89-00293 5C

BENSON-EVANS, K.
Algal Studies of the River Ely, South Wales, U.K.: I. Phytoplankton,
W89-00678 2H

Algal Studies of the River Ely, South Wales, U.K.: II. Epilithic Algae,
W89-00679 2H

BENSTED, I. H.
London Water Ring Main,
W89-00840 5F

BERG, J.
Developmental Defects in Pelagic Fish Embryos from the Western Baltic,
W89-00315 5C

BERG, J. D.
Rapid Detection of Total and Fecal Coliforms in Water by Enzymatic Hydrolysis of 4-Methylumbelliferone-beta-D-Galactoside,
W89-00734 5A

BERGE, D.
Lake Enrichment by Submersed Macrophytes: A Norwegian Whole-Lake Experience with Elodea canadensis,
W89-00131 2H

BERGMAN, A.
Analysis of Halogenated Polycyclic Aromatic Hydrocarbons in Urban Air, Snow and Automobile Exhaust,
W89-00613 5B

BERGMAN, M. J. N.
Dredging Activities in the Dutch Wadden Sea: Effects on Macrobenthic Infauna,
W89-00151 2L

BERGSTROM, B.
Investigations of Chlorinated Thiophenes: A Group of Bioaccumulable Compounds Identified in the Effluents from Kraft Bleaching,
W89-00360 5B

BERKAS, W. R.
Comparison of Instream and Laboratory Methods of Measuring Sediment Oxygen Demand,
W89-00869 7B

BERKOWITZ, B.
Continuum Models for Contaminant Transport in Fractured Porous Formations,
W89-00966 5B

BERLIN, V. V.
Reconstruction of the Surge Tank of the Sengilei Hydroelectric Station,
W89-00546 8C

BERMOND, A.
Use of Factorial Experimental Design to Evaluate How Biotic and Abiotic Factors Influence Cadmium Accumulation in the Unicellular Alga Dunaliella bioculata,
W89-01043 5B

BERNARD, N. D.
Distribution of Arsenic in the Sediments and Biota of Hilo Bay, Hawaii,
W89-00677 5B

BERNARD, R.
Estimation of Bare Soil Evaporation from Airborne Measurements,
W89-00352 7B

BERNDTSSON, R.
Spatial and Temporal Scales in Rainfall Analysis Some Aspects and Future Perspectives,
W89-01021 2B

Temporal Variability in Spatial Correlation of Daily Rainfall,
W89-01247 2B

BERNER, T.
Measurement of Primary Productivity in a High-Rate Oxidation Pond (HROP),
W89-00213 2H

BERNHARDT, H.
Chemical Methods of P-Elimination in the Tributaries of Reservoirs and Lakes,
W89-00020 5G

Strategies of Lake Sanitation,
W89-00017 5G

BERRYMAN, D.
Nonparametric Tests for Trend Detection in Water Quality Time Series,
W89-00867 7C

BERTNESS, M. D.
Peat Accumulation and the Success of Marsh Plants,
W89-00909 2H

BESCHTA, R. L.
Flow Capacity of Culverts on Oregon Coast Range Forest Roads,
W89-00878 8B

BEST, J. L.
Sediment Transport and Bed Morphology at River Channel Confluences,
W89-00411 2J

BESTUZHEVA, N. P.
Hydraulic Tests for Reconstructing the Pumping Stations on the Moscow Canal,
W89-00055 8C

BEUKEMA, J. J.
Dredging Activities in the Dutch Wadden Sea: Effects on Macrobenthic Infauna,
W89-00151 2L

BEVEN, K. J.
Hydrological Heterogeneity Catchment Morphology and Catchment Response,
W89-01024 2A

BHASIN, V. K.
Lake Dredging Boosts Recreational and Esthetic Environments,
W89-00468 5G

BHOWMIK, N. G.
Long-Term Ecological Research on Illinois Rivers,
W89-00401 2H

Scour Channel Development after Spillway Failure,
W89-00897 2J

BIERCK, B. R.
Compressible Cake Filtration: Monitoring Cake Formation and Shrinkage Using Synchrotron X-rays,
W89-00512 5D

BIGG, E. K.
Persistent Effects of Cloud Seeding with Silver Iodide,
W89-00091 3B

Secondary Ice Nucleus Generation by Silver Iodide Applied to the Ground,
W89-00088 3B

BIGHAM, J. M.
Properties of Water Treatment Lime Sludges and Their Effectiveness as Agricultural Limestone Substitutes,
W89-00516 5F

BIGRAS, S. C.
Evaporation from Mackenzie Delta Lakes, N.W.T., Canada,
W89-00438 2D

BIKINEEV, M. G.
Prospects of Improving the Prediction of the Hazard of Rock Bursts During Tunneling,
W89-00038 8E

BIKSHAM, G.
Sediment Transport of the Godavari River Basin and Its Controlling Factors,
W89-01211 2J

BILLEN, G.
Nitrogen Budget of the Scheldt Hydrographical Basin,
W89-00155 5B

BILLINGS, R. B.
Effects of Rate Structure Knowledge on Household Water Use,
W89-00877 6D

BINKLEY, C.
Role of Economic Benefits Analysis in Funding Marine Combined Sewer Overflow Projects - Case Study of Boston Harbor,
W89-01132 6C

BINKLEY, K. S.
Occurrence and Distribution of Trace Organic Compounds in Bermuda Precipitation,
W89-01148 5B

BIRD, S.
Stream Acidification Trends in the Welsh Uplands: A Modelling Study of the Llyn Brianne Catchments,
W89-01206 5C

BIRKHOLZ, D. A.
Is Water a Relevant Sampling Medium for Toxic Chemicals: An Alternative Environmental Sensing Strategy,
W89-01162 5A

BISHOP, J. D. D.
Comparison of the Fauna Retained On 0.5 mm and 1.0 mm Meshes from Benthic Samples Taken in the Beatrice Oilfield, Moray Firth, Scotland,
W89-00783 2L

Macrobenthos of the Beatrice Oilfield, Moray Firth, Scotland,
W89-00782 2L

BISHOP, P. L.
Leaching of Inorganic Hazardous Constituents from Stabilized/Solidified Hazardous Wastes,
W89-00999 5E

BISSONNETTE, G. K.
Metabolic Processes Involved in Repair of Escherichia coli Cells Damaged by Exposure to Acid Mine Water,
W89-00727 5C

BITTON, G.
Novel Approach for Modifying Microporous Filters for Virus Concentration from Water,
W89-00332 5A

BLAIS, J. S.
Toxicity of Alkyllead Salts to Anaerobic Nitrogen Transformations in Sediment,
W89-01167 5C

BLAND, L. A.
Efficacy of Chemical Dosing Methods for Isolating Nontuberculous Mycobacteria from Water Supplies of Dialysis Centers,
W89-00343 5A

BLANTON, L. R.
Biomass Production and Nutrient Cycling in Aquatic Macrophyte Communities of the Chowan River, North Carolina,
W89-00097 2H

BLOOMSBURG, G. L.
Explicit Solution to Green-Ampt Equation for Nonuniform Soils,
W89-00760 7B

BOATNER, L. A.
Surface Reactions of Synthetic, End-member Analogues of Monazite, Xenotime and Rhabdophane, and Evolution of Natural Waters,
W89-01080 2K

BOBEE, B.
Confidence Intervals for Flood Events Under a Pearson 3 or Log Pearson 3 Distribution,
W89-00879 7C

Generalized Method of Moments Applied to LP3 Distribution,
W89-00901 2E

Nonparametric Tests for Trend Detection in Water Quality Time Series,
W89-00867 7C

BOCHAROV, V. V.
50th Anniversary of the Moscow Canal,
W89-00049 8A

BODAMMER, J. E.
Corneal Damage in Larvae of Striped Bass Morone saxatilis Exposed to Copper,
W89-00380 5C

BODIN, P.
Results of Ecological Monitoring of Three Beaches Polluted by the 'Amoco Cadiz' Oil Spill: Development of Meiofauna from 1978 to 1984,
W89-01031 5C

BODY, D. N.
Landscape and Rainfall Indices for Prediction of Streamflow Similarities in the Hunter Valley, Australia,
W89-00972 2E

BOGARDI, I.
Systems Approach to Nitrate Removal from Groundwater Supplies,
W89-00134 5F

BOGNER, W. C.
Scour Channel Development after Spillway Failure,
W89-00897 2J

BOHM, M.
Rain Acidity in Stellenbosch,
W89-00454 5A

BOHN, C. C.
Bacterial Water Quality Responses to Four Grazing Strategies: Comparisons with Oregon Standards,
W89-01170 5B

BOKI, K.
Adsorption of Indigo Carmine by Activated Carbon,
W89-00633 5D

BOND, A. M.
Instrumentation for 7-Day Continuous Cycle Monitoring of Metals with Automated On-Line Sample Preparation, High-Performance Liquid Chromatography, and Electrochemical Detection,
W89-00210 5A

BONDARENKO, A. D.
Prospects of Improving the Prediction of the Hazard of Rock Bursts During Tunneling,
W89-00038 8E

BONEY, A. D.
Seasonal Studies on the Phytoplankton and Primary Production in the Inner Firth of Clyde,
W89-00812 2L

BONNEL, B.
Comparison of Model-Generated and Satellite-derived Cloud Cover and Radiation Budget,
W89-01262 2A

BOOKE, H. E.
Streamflow Regulation and Fish Community Structure,
W89-01053 4A

BOON, J. J.
Effects of the Season and of Water Chemistry on the Decomposition of Nymphaea alba L.: Weight Loss and Pyrolysis Mass Spectrometry of the Particulate Matter,
W89-00096 2H

BOON, P. J.
Impact of River Regulations on Invertebrate Communities in the U.K.,
W89-00959 4A

BOOTY, W. G.
Drainage Basin Control of Acid Loadings to Two Adirondack Lakes,
W89-00710 5B

BORAAS, M. E.
Phagotrophic Phototrophs: The Ecological Significance of Mixotrophy,
W89-00384 2H

BORG, H.
Effect of Logging and Regeneration on Groundwater, Streamflow and Stream Salinity in the Southern Forest of Western Australia,
W89-00350 4C

BORGIANELLI-SPINA, P. I. G.
Modern Management Standards of Water Network Register (Criteres Modernes de Gestion du Cadastre des Reseaux d'Eau),
W89-00919 5F

BORN, S. M.
Assessing Networked Coastal Zone Management Programs,
W89-00290 6B

BORTKEVICH, S. V.
New Pumped-Storage Station Designs,
W89-00556 8C

BOSMA, T. N. P.
Simulation Model for Biotransformation of Xenobiotics and Chemotaxis in Soil Columns,
W89-00989 5B

BOTTENHEIM, J. W.
Winter Cloud Water and Air Composition in Central Ontario,
W89-01265 5C

BOUCHARD, D. C.
Sorption Nonequilibrium During Solute Transport,
W89-00988 5B

BOUCHEZ, R.
Chernobyl 134Cs, 137Cs, and 210Pb in High Mountain Lake Sediment: Measurements and Modeling of Mixing Process,
W89-00271 5B

BOUDREAU, B. P.
Basin Sedimentation and the Growth of Prograding Deltas,
W89-00832 2J

Provisional Diagenetic Model for pH in Anoxic Porewaters: Application to the FOAM Site,
W89-00767 2J

BOURQUIN, A. W.
Biotic and Abiotic Degradation Rates of Methyl Parathion in Freshwater and Estuarine Water and Sediment Samples,
W89-00601 5B

BOUWER, E.
Coping with Groundwater Contamination,
W89-01135 5G

BOWDERS, J. J.
Interaction of Earthen Liner Materials with Industrial Waste Leachate,
W89-00997 5E

BOWERS, C. E.
Extreme Pressures in Hydraulic-Jump Stilling Basins,
W89-00896 8B

BOVARSKII, V. M.
Experience in Operating Hydraulic Structures and Equipment of Hydroelectric Stations,
W89-00554 8C

BOYLE, E. A.
Variability of Dissolved Trace Metals in the Mississippi River,
W89-01075 5B

BOYLE, P. R.
Intertidal Macrofauna of Nigg Bay,
W89-00780 2L

BOYLEN, C. W.
Patterns of Epipelic Algal Distribution in an Acidic Adirondack Lake,
W89-00298 2H

BRADLEY, S. B.
Recent Transport of Metals in the River Severn as Recorded by the Sediments of Chelmarsh Reservoir, Shropshire, U.K.,
W89-00885 5B

BRAESTER, C.
Continuum Models for Contaminant Transport in Fractured Porous Formations,
W89-00966 5B

BRAHANA, J. V.
Dry Stream Reaches in Carbonate Terranes: Surface Indicators of Ground-Water Reservoirs,
W89-00870 7B

BRAHME, M. V.
Planning and Construction of the Pahalgam Scheme,
W89-01004 8A

BRAMMER, E. S.
Photosynthesis of Submersed Macrophytes in Acidified Lakes: II. Carbon Limitation and Utilization of Benthic CO2 Sources,
W89-00095 5C

BRANCH, G. M.
Annual Cycle of Free-Floating Bacteria in the Bot River Estuary,
W89-00658 2L

Changes in the Fish Fauna of the Bot River Estuary in Relation to Opening and Closure of the Estuary Mouth,
W89-00665 2L

Effect of Salinity and Temperature Variations on the Bacterial Population in the Bot River Estuary,
W89-00657 2L

Synopsis of the Impact of Artificially Opening the Mouth of the Bot River Estuary: Implications for Management,
W89-00666 2L

BRANIEWSKI, S.
Influence of Dusts from Chosen Industrial Plants on Particular Links of Forest Ecosystem of the Niepolomice Forest,
W89-00081 5C

BRANNON, E. L.
Homing of Adult Chinook Salmon after Brief Exposure to Whole and Dispersed Crude Oil,
W89-00375 5C

BRAS, R. L.
Fractal Nature of River Networks,
W89-00975 2E

Multidimensional Modeling of Cumulative Rainfall: Parameter Estimation and Model Adequacy through a Continuum of Scales,
W89-00706 2B

BRAVO, R.
Animal Wastes Media for Spirulina Production,
W89-00136 5D

BRECK, J. E.
Potential Importance of Spatial and Temporal Heterogeneity in pH, Al, and Ca in Allowing Survival of a Fish Population: A Model Demonstration,
W89-01052 5C

BREEMAN, A. M.
Population Dynamics of a Tropical Intertidal and Deep-Water Population of Sargassum polyceratium (Phaeophyceae),
W89-00528 2L

BREN, L. J.
Use of Map Analysis to Elucidate Flooding in an Australian Riparian River Red Gum Forest,
W89-00722 2E

BRETSCHKO, G.
Determination of Organic Matter in River Sediments,
W89-00169 7B

BREWIN, D. J.
Water Quality Management: A Regional Perspective-The Severn-Trent Area,
W89-00951 5G

BRILL, E. D.
Cost Efficiency of Transferable Discharge Permit Markets for Control of Multiple Pollutants,
W89-00697 5G

Method for Locating Wells in a Groundwater Monitoring Network Under Conditions of Uncertainty,
W89-00971 7A

BRINKMAN, J.
Reliability of Chemical Analyses of Water Samples: The Experience of the UMTRA Project,
W89-00941 5A

BRINSON, M. M.
Biomass Production and Nutrient Cycling in Aquatic Macrophyte Communities of the Chowan River, North Carolina,
W89-00097 2H

BRITTAN, C.
Loss of Seagrass in Cockburn Sound, Western Australia: II. Possible Causes of Seagrass Decline,
W89-00116 5C

BROADHURST, V. L.
Sea-Surface Microlayer of Puget Sound: Part II: Concentrations of Contaminants and Relation to Toxicity,
W89-00854 5C

BROBERG, O.
Delayed Nutrient Responses to the Liming of Lake Gardsjon, Sweden,
W89-00441 5G

BROCK, T. C. M.
Effects of the Season and of Water Chemistry on the Decomposition of Nymphaea alba L.: Weight Loss and Pyrolysis Mass Spectrometry of the Particulate Matter,
W89-00096 2H

BRODERICK, G. P.
Interaction of Earthen Liner Materials with Industrial Waste Leachate,
W89-00997 5E

BRONSWIJK, J. J. B.
Modelling Soil Water Dynamics in the Unsaturated Zone: State of the Art,
W89-01014 2G

BROWN, J. M. B.
Finite Element Computation of Shape Factors for Kirkham's Piezometer Tube Method for Hydraulic Conductivity of Saturated Soil,
W89-00911 2G

BROWN, J. S.
Hydrocarbon and Pollutant Levels in the Cromarty Firth,
W89-00791 5B

BROWN, K. W.
Estimation of the Risk Associated with the Organic Constituents of Hazardous and Municipal Waste Landfill Leachates,
W89-00995 5B

BROWN, L. R.
Influence of Temperature on Microhabitat Choice by Fishes in a California Stream,
W89-00027 2H

BROWN, M. K.
Organochlorine and Mercury Residues in Wild Mink and Otter: Comparison with Fish,
W89-01093 5B

BROWN, M. P.
Sedimentation of 74 PCB Congeners in the Upper Hudson River,
W89-00584 5B

BROWN, T. C.
Do Water Market Prices Appropriately Measure Water Values,
W89-00837 6D

BRUCE, R. R.
Effect of Assumed Unit Gradient During Drainage on the Determination of Unsaturated Hydraulic Conductivity and Infiltration Parameters,
W89-00407 2G

BRUCHET, A.
Chloropicrin in Potable Water: Conditions of Formation and Production during Treatment Processes (La Chloropicrine dans les Eaux Potables: Conditions de Formation et Evolution le long des Filieres de Traitement),
W89-00635 5F

BRUMMELHUIS, E. B. M.
Effects on the Benthic Fauna of Embanking an Intertidal Flat Area (The Markiezaat, Eastern Scheldt Estuary, The Netherlands),
W89-00676 6G

BRUNETTI, R.
Micronucleus Test: Examples of Application to Marine Ecology,
W89-01042 5A

BRUNSON, K. L.
Summary of Reported Fish Kills in Kansas During 1982,
W89-00393 5C

BRUTON, J. E.
Particulate Concentrations in Lake St. Clair as Recorded by a Shipborne Multispectral Optical Monitoring System,
W89-00066 7B

BRUVOLD, W. H.
Developing and Assessing a Model of Residential Water Conservation,
W89-00881 3D

BRYAN, R. B.
Solute Sources and Transport in an Ephemeral Badland Catchment, Southeastern Alberta, Canada,
W89-00046 2J

BRYANT, C. W.
Biosorption of Organic Halide in a Kraft Mill Generated Lagoon,
W89-01138 5D

Factors Affecting Coagulation with Aluminum Sulfate: I. Particle Formation and Growth,
W89-01221 5F

BRYON, E. R.
Recurrence of Daphnia rosea in Lake Tahoe: Analysis of a Population Pulse,
W89-00216 2H

BU'ALI, A. M.
Isolation, Identification and Characterisation of Filamentous and Floc-Forming Bacteria from Activated Sludge Flocs,
W89-00648 5D

BUCHANAN, D.
Regulation of Pollution: Controls and Responsibilities,
W89-00786 6E

BUDD, D. A.
Aragonite-to-Calcite Transformation During Fresh-Water Diagenesis of Carbonates: Insights from Pore-Water Chemistry,
W89-01076 2K

BUIJSMAN, E.
Wet Deposition of Ammonium in Europe,
W89-00765 2B

BUKATA, R. P.
Particulate Concentrations in Lake St. Clair as Recorded by a Shipborne Multispectral Optical Monitoring System,
W89-00066 7B

BULL, A. T.
Contribution of Plasmids to Naphthalene Catabolism in Sediment Bacteria,
W89-00378 5B

BULTOT, F.
Repercussions of a CO2 Doubling on the Water Cycle and on the Water Balance - A Case Study for Belgium,
W89-00355 2A

BURCHARDT, L.
Changes in Chlorophyll Contents of Swietokrzyskie Lake Phytoplankton, as Related to Qualitative and Quantitative Fluctuations of Phytoplankton Density and of the Physicochemical Conditions in this Lake in Summer 1979,
W89-00257 5C

Qualitative and Quantitative Changes in Phytoplankton on the Background of Physicochemical Changes in the Water of Swietokrzyskie Lake in the Years 1977-1979,
W89-00258 5C

BURENKOVA, V. V.
Assignment of the Characteristics of Clay-Rubble Soils in Watertight Components of Earth Dams,
W89-00036 8D

BURGI, H.
Drift of Zooplankton in a Lake-Outlet (Glatt) in a Day-Night-Rhythm Depending from the Water Level,
W89-00025 2H

BURIEZ, J. C.
Comparison of Model-Generated and Satellite-derived Cloud Cover and Radiation Budget,
W89-01262 2A

BURNESS, H. S.
Management of a Tributary Aquifer,
W89-00978 4B

BURNHAM, J. C.
Myxococcal Predation on Cyanobacterial Populations: Nutrient Effects,
W89-01050 2H

BURSEY, C. R.
Unionid (Mollusca:Bivalvia) Fauna of the Shenango River in Mercer County, Pennsylvania,
W89-00312 5C

BURT, T. P.
Stream Nitrate Levels in a Small Catchment in South West England Over a Period of 15 Years (1970 - 1985),
W89-00915 5B

BURTON, N. F.
Contribution of Plasmids to Naphthalene Catabolism in Sediment Bacteria,
W89-00378 5B

BUSATTI, G.
Sediment-Water Core Sampler for Coastal Pollution Studies,
W89-00641 5A

BUSH, B.
Sedimentation of 74 PCB Congeners in the Upper Hudson River,
W89-00584 5B

BUSH, D. B.
Do Water Market Prices Appropriately Measure Water Values,
W89-00837 6D

BUSS, M. D.
State Program Solves County Salt Storage Problem,
W89-00466 5G

BUTH, G. J. C.
Decomposition of Roots of Three Plant Communities in a Dutch Salt Marsh,
W89-00527 2L

BUTKUS, S. R.
Lake Response Modeling Using Biologically Available Phosphorus,
W89-01236 5C

BUTLER, J. J.
Pumping Tests in Nonuniform Aquifers: The Radially Symmetric Case,
W89-01196 2F

BUTTERWORTH, B. D.
Bioavailability of Polychlorinated Dibenzo-p-dioxins and Dibenzofurans from Contaminated Wisconsin River Sediment to Carp,
W89-00583 5B

BYRNE, C. J.
Contributions of Heavy Metals from Municipal Runoff to the Sediments of Lake Pontchartrain, Louisiana,
W89-00618 5B

CABANISS, S. E.
Copper Binding by Dissolved Organic Matter: I. Suwannee River Fulvic Acid Equilibria,
W89-01077 5B

Copper Binding by Dissolved Organic Matter: II. Variation in Type and Source of Organic Matter,
W89-01078 5B

CABRERA, F.
Heavy Metal Pollution in the Guadiamar River and the Guadalquivir Estuary (South West Spain),
W89-00573 5B

CABRERA, S.
Short-term Dynamics of a Melosira Population in the Plankton of an Impoundment in Central Chile,
W89-00214 2H

CADEE, G. C.
Increased Phytoplankton Primary Production in the Marsdiep Area (Western Dutch Wadden Sea),
W89-00674 5C

CADEE, K.
Kinetics of Sulfide Oxidation by Dissolved Oxygen,
W89-01130 5D

CADENA, F.
Evaluation of Chemical Oxidizers for Hydrogen Sulfide Control,
W89-01129 5D

CADET, D. L.
Southwest Branch of the North American Monsoon During Summer 1979,
W89-00845 2A

CAHILL, R. A.
Long-Term Ecological Research on Illinois Rivers,
W89-00401 2H

CAHOON, D. R.
Marsh Management Plans in Practice: Do They Work in Coastal Louisiana, USA,
W89-01060 2L

CAIRNCROSS, B.
Roles of Sedimentation and Plant Growth in Changing Flow Patterns in the Okavango Delta, Botswana,
W89-00457 2J

CAIRNS, J.
Effect of a Heated Wastewater Discharge upon River Protozoan Species Pool Variability through Time and Space,
W89-00077 5C

CALABRESE, E. A.
Basin Sedimentation and the Growth of Prograding Deltas,
W89-00832 2J

CALIXTE, J. M.
Twinning: Utility Pairing,
W89-00424 5F

CAMBRIDGE, M. L.
Loss of Seagrass in Cockburn Sound, Western Australia: II. Possible Causes of Seagrass Decline,
W89-00116 5C

CAMERON, P.
Developmental Defects in Pelagic Fish Embryos from the Western Baltic,
W89-00315 5C

CAMPBELL, D. J.
Soil Solution in a Soil Treated with Digested Sewage Sludge,
W89-00413 5B

CAMPBELL, M. L.
Sorption Nonequilibrium During Solute Transport,
W89-00988 5B

CAMPO, A. M.
Epidemiological Study of the Legionella pneumophila Presence in Potable Water in Alicante,
W89-00925 5A

CANALE, R. P.
Load Allocation for Toxics Using Monte Carlo Techniques,
W89-00514 5G

CANFIELD, D. W.
Provisional Diagenetic Model for pH in Anoxic Porewaters: Application to the FOAM Site,
W89-00767 2J

CANNON, C. E.
MCRT for Control of Cokemaking Wastewater treatment,
W89-01139 5D

CANNON, R. C.
Release of Micro-algal Photosynthate and Associated Bacterial Uptake and Heterotrophic Growth,
W89-01187 2H

CAPDEVILLE, B.
Selected Dyes for Residence Time Distribution Evaluation in Bioreactors,
W89-00404 5D

CAPE, J. N.
Influence of Altitude on Rainfall Composition at Great Dun Fell,
W89-01146 5B

Influence of Altitude on Wet Deposition: Comparison between Field Measurements at Great Dun Fell and the Predictions of a Seeder-Feeder Model,
W89-01147 5B

CAPONE, D. G.
Effects of Co-Occurring Aromatic Hydrocarbons on Degradation of Individual Polycyclic Aromatic Hydrocarbons in Marine Sediment Slurries,
W89-00339 5B

CARBONARA, P. A.
Seasonal Abundance and Distribution of Drift Algae and Seagrasses in the Mid-Indian River Lagoon, Florida,
W89-00104 2L

CAREY, J. H.
Is Water a Relevant Sampling Medium for Toxic Chemicals: An Alternative Environmental Sensing Strategy,
W89-01162 5A

CARLBERG, G. E.
Investigations of Chlorinated Thiophenes: A Group of Bioaccumulable Compounds Identified in the Effluents from Kraft Bleaching,
W89-00360 5B

Methods for Determination of Sum Parameters and Characterization of Organochlorine Compounds in Spent Bleach Liquors from Pulp Mills and Water, Sediment and Biological Samples from Receiving Waters,
W89-00358 5A

CARLIER, E.
Modeling of Tracer Spreading in a Fracture in which the Aperture Decreases with Depth in a Laminar Flow (Modelisation de la Propagation d'un Traceur dans une Fracture qui se Ferme Progressivement en Profondeur dans l'Hypothese d'un Ecoulement Laminaire Parallele),
W89-01214 2F

CARLING, P. A.
Channel Change and Sediment Transport in Regulated U.K. Rivers,
W89-00958 2J

CARLSON, L.
Iron Oxide Formation in Artificial Ground Waters,
W89-00687 2F

CARLSON, L. E.
Subsoil Investigation of Ice Lensing at the Calgary, Canada, Frost Heave Test Facility,
W89-00389 2C

CARLSON, P. C.
Effects of Season and Substrate on Availability of Drift for Fish in a Small Warmwater Stream,
W89-00400 2H

CARLSON, P. R.
Nitrate and Ammonium Uptake by Plankton in an Amazon River Floodplain Lake,
W89-00229 2H

CARNEY, H. J.
Seasonal Phytoplankton Demographic Processes and Experiments on Interspecific Competition,
W89-00906 2H

CARON, D. A.
Dynamics of Protistan Carbon and Nutrient Cycling,
W89-00383 2L

CARPENTER, S. R.
Effects of Fish Nests on Pattern and Zonation of Submersed Macrophytes in a Softwater Lake,
W89-00092 2H

CARSON, L. A.
Efficacy of Chemical Dosing Methods for Isolating Nontuberculous Mycobacteria from Water Supplies of Dialysis Centers,
W89-00343 5A

CARTER, V.
Effect of Sediment Depth and Sediment Type on the Survival of Vallisneria americana Michx Grown from Tubers,
W89-00114 2H

Effects of Grazers and Light Penetration on the Survival of Transplants of Vallisneria americana Michx in the Tidal Potomac River, Maryland,
W89-00108 2H

CARTLEDGE, F.
Effects of Three Organics on Selected Physical Properties of Type I Portland Cement,
W89-00994 5E

CARTLEDGE, F. W.
Transmission Electron Microscopic Study of Solidified/Stabilized Organics,
W89-01000 5E

CASPERS, N.
Ecological and Saprobiological Status of the Rhine (Der Oekologisch-Saprobiologische Zustand des Rheins),
W89-00498 2H

CASSEL, D. K.
Effect of Assumed Unit Gradient During Drainage on the Determination of Unsaturated Hydraulic Conductivity and Infiltration Parameters,
W89-00407 2G

CASWELL, B.
Esker Aquifers,
W89-00264 4B

CATALLO, W. J.
Effects of High Levels of Polycyclic Aromatic Hydrocarbons on Sediment Physicochemical Properties and Benthic Organisms in a Polluted Stream,
W89-00589 5C

CAULKINS, P.
Role of Economic Benefits Analysis in Funding Marine Combined Sewer Overflow Projects - Case Study of Boston Harbor,
W89-01132 6C

CAVADIAS, G.
Approximate Confidence Intervals for Verification Criteria of the WMO Intercomparison of Snowmelt Runoff Models,
W89-01143 2E

CECCHERELLI, V. U.
Trophic State Gradients and Zooplankton and Zoobenthos Distribution in a Po River Delta Lagoon,
W89-00580 2L

CECCHI, F.
Comparison of Co-Digestion Performance of Two Differently Collected Organic Fractions of Municipal Solid Waste with Sewage Sludges,
W89-00643 5D

CESSAR, L. R.
Accumulation of Polycyclic Aromatic Hydrocarbons in Acid Sensitive Lakes,
W89-01074 5B

CHALE, F. M. M.
Effects of a Cyperus papyrus L. Swamp on Domestic Waste Water,
W89-00107 5D

CHAMBERS, P. A.
Influence of Sediment Composition and Irradiance on the Growth and Morphology of Myriophyllum spicatum L.,
W89-00098 2H

CHAMBON, P.
Predictive Structure-Toxicity Model with Daphnia magna,
W89-00591 5C

CHAMBON, R.
Predictive Structure-Toxicity Model with Daphnia magna,
W89-00591 5C

CHAN, H. H.
Routine Determination of Polychlorinated Biphenyl Residues in Fish and Shellfish in Taipei County,
W89-00605 5A

CHAND, R.
Validity of the Environmental Chloride Method for Recharge Evaluation of Coastal Aquifers, India.
W89-00356 7B

CHANDLER, A. S.
Field Study of the Cloud Chemistry and Cloud Microphysics at Great Dun Fell,
W89-00308 5B

CHANG, H. H.
Sediment Delivery in a Semi-arid Coastal Stream,
W89-00346 2J

CHANG, J. S.
Comparisons of RADM and Oscar Precipitation Chemistry Data,
W89-00433 5B

CHANG, T. J.
Stochastic Forecast of Water Losses,
W89-00759 7B

CHANGNON, S. A.
Climatography of Thunder Events in the Conterminous United States: Part I: Temporal Aspects,
W89-00274 2B

Climatography of Thunder Events in the Conterminous United States: Part II: Spatial Aspects,
W89-00275 2B

CHAO, S. Y.
River-Forced Estuarine Plumes,
W89-00414 2L

CHAPIN, F. S.
Productivity and Nutrient Cycling of Alaskan Tundra: Enhancement by Flowing Soil Water,
W89-00908 2G

CHAPMAN, T. G.
Problems of Rainfall-Runoff Modelling in Arid and Semiarid Regions,
W89-01144 2E

CHARREL, M.
Comparison of Bacterial Indicators and Sampling Programs for Drinking Water Systems,
W89-00733 5A

CHASTRETTE, M.
Predictive Structure-Toxicity Model with Daphnia magna,
W89-00591 5C

CHE, M. D.
Properties of Water Treatment Lime Sludges and Their Effectiveness as Agricultural Limestone Substitutes,
W89-00516 5F

CHEN, C.
Analytical Solution for Aquifer Decontamination by Pumping,
W89-00977 5G

CHEN, Y.-L.
Life Cycle Effects of Cloud Clusters on the Moisture Distribution over the Eastern Atlantic,
W89-00417 2B

CHERRY, D. S.
Metallothionein-Like Heavy Metal Binding Protein Levels in Asiatic Clams Are Dependent on the Duration and Mode of Exposure to Cadmium,
W89-01228 5B

CHERRY, J. A.
Hydrogeology of Two Saskatchewan Tills. I. Fractures, Bulk Permeability, and Spatial Variability of Downward Flow,
W89-01201 2F

CHESTER, P. F.
Other Forms of Environmental Pollution,
W89-00794 5B

CHIBISOV, I. T.
Hydropower Equipment of the Moscow Canal,
W89-00054 8C

CHIFFINGS, A. W.
Loss of Seagrass in Cockburn Sound, Western Australia: II. Possible Causes of Seagrass Decline,
W89-00116 5C

CHIN-LEO, G.
Estimating Bacterial Production in Marine Waters from the Simultaneous Incorporation of Thymidine and Leucine,
W89-00729 7B

CHIN, Y. P.
Estimating Soil/Sediment Partition Coefficients for Organic Compounds by High Performance Reverse Phase Liquid Chromatography,
W89-01223 5B

CHLODNY, J.
Influence of Dusts from Chosen Industrial Plants on Particular Links of Forest Ecosystem of the Niepolomice Forest,
W89-00081 5C

CHOI, D. S.
Speciation Studies of Copper and Magnesium in Duckweed Extract Using Interfaced HPLC and Thermospray Neubulizer Flame AA,
W89-00886 5D

CHOQUET, C. G.
Statistical Considerations Associated with the Use of the Heterotrophic Activity Method for

Estimating V sub max and K' for Aquatic Environments,
W89-00280 7C

CHOU, A. C.
Transmission Electron Microscopic Study of Solidified/Stabilized Organics,
W89-01000 5E

CHOU, C.-S.
Degradation of Bisphenol A in Natural Waters,
W89-00600 5B

CHOU, S. S.
Routine Determination of Polychlorinated Biphenyl Residues in Fish and Shellfish in Taipei County,
W89-00605 5A

CHOULARTAN, T. W.
Influence of Altitude on Wet Deposition: Comparison between Field Measurements at Great Dun Fell and the Predictions of a Seeder-Feeder Model,
W89-01147 5B

CHOULARTON, T. W.
Field Study of the Cloud Chemistry and Cloud Microphysics at Great Dun Fell,
W89-00308 5B

Influence of Altitude on Rainfall Composition at Great Dun Fell,
W89-01146 5B

CHRISTENSEN, S. W.
Potential Importance of Spatial and Temporal Heterogeneity in pH, Al, and Ca in Allowing Survival of a Fish Population: A Model Demonstration,
W89-01052 5C

CHRISTIANSEN, R.
Leaf Production and Nitrogen and Phosphorus Tissue Content of Littorella uniflora (L.) Aschers. in Relation to Nitrogen and Phosphorus Enrichment of the Sediment in Oligotrophic Lake Hampen, Denmark,
W89-00101 5C

CHRISTOPHERSEN, N.
Assessing the Birkenes Model of Stream Acidification Using a Multisignal Calibration Methodology,
W89-00974 7B

Multisignal Automatic Calibration Methodology for Hydrochemical Models: A Case Study of the Birkenes Model,
W89-00973 5B

CHRZANOWSKA, E.
Influence of Dusts from Chosen Industrial Plants on Particular Links of Forest Ecosystem of the Niepolomice Forest,
W89-00081 5C

CHUAPHANICH, P.
Improving Water Supply in Thailand,
W89-00422 5F

CHURCH, T. M.
Atmospheric Deposition of Arsenic and Association with Acid Precipitation,
W89-00431 5B

CLARK, R. M.
Contaminant Propagation in Distribution Systems,
W89-00494 5F

GAC Treatment Cost Experience at Two Drinking Water Utilities,
W89-00495 5F

Modeling Contaminant Propagation in Drinking Water Distribution Systems,
W89-00929 5F

CLARKE, A. G.
Dissolution of Trace Metals from Particles of Industrial Origin and Its Influence on the Composition of Rainwater,
W89-01149 5B

CLARKE, M. J.
Peatland Soil-Plant Relationships in the New Forest,
W89-00122 2H

CLARKE, P. J.
Nitrogen Pools and Soil Characteristics of a Temperate Estuarine Wetland in Eastern Australia,
W89-00110 5B

CLASEN, J.
Chemical Methods of P-Elimination in the Tributaries of Reservoirs and Lakes,
W89-00020 5G

CLEAVELAND, M. K.
Texas Drought History Reconstructed and Analyzed from 1698 to 1980,
W89-00273 2B

CLEMENT, R. E.
Emissions of Chlorinated Organics from a Municipal Sewage Sludge Burning Incinerator,
W89-00607 5B

CLEVERLY, G. J.
Use of Network Analysis Techniques in the Development and Optimization of a large UK Urban Water Distribution System (L'Emploi de Techniques),
W89-00918 5F

CLIFFORD, D.
Evaluating Various Adsorbents and Membranes for Removing Radium from Groundwater,
W89-01109 5F

CLIVER, D. O.
Transport Modelling of Biological Tracers from Septic Systems,
W89-01226 5B

CLUCKIE, I. D.
Identification of Rainfall Type From Weather Radar Data,
W89-00842 2B

CLUIS, D.
Nonparametric Tests for Trend Detection in Water Quality Time Series,
W89-00867 7C

CLYDE, S. E.
Drafting Purchase and Sale Agreements Affecting Water Rights,
W89-01252 6E

COCKERHAM, L. G.
Long-term Study of Ecosystem Contamination with 2,3,7,8-Tetrachlorodibenzo-p-dioxin,
W89-00603 5B

COETZEE, D. J.
Zooplankton and Some Environmental Conditions in the Bot River Estuary,
W89-00659 2L

COGGER, C. G.
Septic System Performance on a Coastal Barrier Island,
W89-01163 5D

COLE, D. W.
Effects of Leaching and Whole-Tree Harvesting on Cation Budgets of Several Forests,
W89-01166 4C

COLE, J. J.
Bacterial Production in Fresh and Saltwater Ecosystems: A Cross-System Overview,
W89-01034 2H

COLEMAN, J. M.
Dynamic Changes and Processes in the Mississippi River Delta,
W89-00469 2J

COLIN, J. L.
Rain-Aerosol Coupling in Urban Area: Scavenging Ratio Measurement and Identification of Some Transfer Processes,
W89-00430 2B

COLLAR, R. H. F.
Water Movement and the Simulation of Storm Surges in the Firth of Clyde,
W89-00803 2L

COLLET, T.
Modeling of Tracer Spreading in a Fracture in which the Aperture Decreases with Depth in a Laminar Flow (Modelisation de la Propagation d'un Traceur dans une Fracture qui se Ferme Progressivement en Profondeur dans l'Hypothese d'un Ecoulement Laminaire Parallele),
W89-01214 2F

COLLIER, C. G.
Identification of Rainfall Type From Weather Radar Data,
W89-00842 2B

COLLIN, J. F.
Comparison of Bacterial Indicators and Sampling Programs for Drinking Water Systems,
W89-00733 5A

COLOSIMO, C.
Friction Factor Evaluation in Gravel-Bed Rivers,
W89-00898 8B

CONJIE, G.
Preliminary Plan for Membrane Desalination in China,
W89-01066 3A

CONLEY, A. H.
National Water Management in the Republic of South Africa: Towards a Consultative Partnership with Diverse Users in a Semi-Arid Country,
W89-01029 6D

CONNELL, D. W.
Age to PCB Concentration Relationship with the Striped Bass (Morone saxatilis) in the Hudson River and Long Island Sound,
W89-00597 5B

CONNOLLY, J. P.
Waste Allocation Simulation Models,
W89-01234 5D

COOK, B. G.
Landscape and Rainfall Indices for Prediction of Streamflow Similarities in the Hunter Valley, Australia,
W89-00972 2E

COOK, P. M.
Bioavailability of Polychlorinated Dibenzo-p-dioxins and Dibenzofurans from Contaminated Wisconsin River Sediment to Carp,
W89-00583 5B

COON, T. G.
Summer Dynamics of the Deep Chlorophyll Maximum in Lake Tahoe,
W89-00224 2H

COOPER, J. G.
Sedimentary Environments and Facies of the Subtropical Mgeni Estuary, Southeast Africa,
W89-01084 2L

COOPER, R. M.
Geostatistics Applied to Groundwater Pollution: III. Global Estimates,
W89-00493 5B

COOPER, S. D.
Spatial and Temporal Distribution Patterns of Three Trophic Levels in a Saline Lake,
W89-00219 2H

COPERTINO, V. A.
Friction Factor Evaluation in Gravel-Bed Rivers,
W89-00898 8B

COPPENS, A.
Repercussions of a CO2 Doubling on the Water Cycle and on the Water Balance - A Case Study for Belgium,
W89-00355 2A

CORDON, R.
Heavy Metal Pollution in the Guadiamar River and the Guadalquivir Estuary (South West Spain),
W89-00573 5B

CORREAE CASTRO, R. M.
Fish Communities in Reservoirs in Southern Brazil (Comunidades de Peixes de Reservatorios no Sul do Brasil),
W89-00011 2H

CORVI, C.
Contamination of Surface Sediments of the Principal Rivers of Geneva Canton by Polychlorinated Biphenyls and DDT (Contamination des Sediments Superficiels des Principales Rivieres du Canton de Geneve par les Polychlorobiphenyles et DDT),
W89-00690 5B

COSBY, B. J.
Modelling the Effects of Acid Deposition: Estimation of Long-Term Water Quality Responses in Forested Catchments in Finland,
W89-00894 5B

COSBY, J.
Stream Acidification Trends in the Welsh Uplands: A Modelling Study of the Llyn Brianne Catchments,
W89-01206 5C

COSPER, E. M.
Induced Resistance to Polychlorinated Biphenyls Confers Cross-Resistance and Altered Environmental Fitness in a Marine Diatom,
W89-00860 5C

PCB-resistant Diatoms in the Hudson River Estuary,
W89-00284 5C

COSSA, D.
Dissolved Mercury Behaviour in the Saint Lawrence Estuary,
W89-00285 5B

COSTA, J. E.
Formation and Failure of Natural Dams,
W89-00470 2J

COSTA-PIERCE, B. A.
Effects of Polyculture and Manure Fertilization on Water Quality and Heterotrophic Productivity in Macrobrachium rosenbergii Ponds,
W89-00327 8I

COSTELLO, M. J.
Characterization of the Interaction Between Viruses and a Solid Polymeric Contact Disinfectant,
W89-00884 5F

COSTERTON, J. W.
Microbial Biomass, Activity, and Community Structure of Water and Particulates Retrieved by Backflow from a Waterflood Injection Well,
W89-00334 5B

COURAU, P.
Dissolved Mercury Behaviour in the Saint Lawrence Estuary,
W89-00285 5B

COUTANT, R. W.
Hydrocarbon Fuel Spill Dispersion on Water: A Literature Review,
W89-00598 5B

COUTINHO, M. E.
Decomposition Rates of Allochthonous Material (Litter) in Lake Carioca - Rio Doce Forest Park - MG (Taxa de Decomposicao do Material Aloctone 'Litter' na Lagoa Carioca - Parque Florestal do Rio Doce - Minas Gerias),
W89-00007 2H

COVERT, D. S.
Changes in Rainwater Acidity Associated with Closure of a Copper Smelter,
W89-00272 5B

COWAN, J. H.
Marsh Management Plans in Practice: Do They Work in Coastal Louisiana, USA,
W89-01060 2L

COX, S. J. B.
Interjurisdictional Management in Chesapeake Bay Fisheries,
W89-01073 6E

COYLE, J. A.
Modeling Contaminant Propagation in Drinking Water Distribution Systems,
W89-00929 5F

CRAIG, D.
Acidification of Shallow Groundwaters During the Spring Melt Period,
W89-00893 5B

CRAMPON, N.
Modeling of Tracer Spreading in a Fracture in which the Aperture Decreases with Depth in a Laminar Flow (Modelisation de la Propagation d'un Traceur dans une Fracture qui se Ferme Progressivement en Profondeur dans l'Hypothese d'un Ecoulement Laminaire Parallele),
W89-01214 2F

CRECELIUS, E. A.
Laboratory Study of the Accumulation and Toxicity of Contaminants at the Sea Surface from Sediments Proposed for Dredging,
W89-00858 5E

Sea-Surface Microlayer of Puget Sound: Part II: Concentrations of Contaminants and Relation to Toxicity,
W89-00854 5C

CREUTIN, J. D.
Rain Measurement by Raingage-Radar Combination: A Geostatistical Approach,
W89-00761 7B

CRIPE, C. R.
Biotic and Abiotic Degradation Rates of Methyl Parathion in Freshwater and Estuarine Water and Sediment Samples,
W89-00601 5B

CROMWELL, J. E.
Role of the States in Solving the Small System Dilemma,
W89-01111 6E

CROSS, F. B.
Global Environment: A Proposal to Eliminate Marine Oil Pollution,
W89-00521 5G

CROSS, J. N.
Contaminant Concentrations and Toxicity of Sea-Surface Microlayer Near Los Angeles, California,
W89-00857 5C

CROW, L. W.
Experimental Marvin Windshield Effects on Precipitation Records in Leadville, Colorado,
W89-00876 7B

CUNNANE, C.
Methods and Merits of Regional Flood Frequency Analysis,
W89-01020 2E

CURRAN, J. C.
Effluent Disposal and the Physical Environment,
W89-00804 5E

CURRIE, M. H.
Variations in the Use of the Bot River Estuary by Water-Birds,
W89-00661 2L

CURTIS, D. J.
Epilithic Diatoms of the Clyde Estuary,
W89-00808 2L

Patterns of Association Between Birds and Invertebrates in the Clyde Estuary,
W89-00811 2L

CUSICK, L. B.
Efficacy of Chemical Dosing Methods for Isolating Nontuberculous Mycobacteria from Water Supplies of Dialysis Centers,
W89-00343 5A

CZERNAS, K.
Changes in Phytoplankton Over a Ten-Year Period in a Lake Undergoing De-Eutrophication due to Surrounding Peat Bogs,
W89-00196 2H

CZUCZWA, J.
Aliphatic and Polycyclic Aromatic Hydrocarbons in Urban Rain, Snow and Fog,
W89-00309 5B

Seasonal and Temporal Changes of Organic Compounds in Rain and Snow,
W89-00429 5B

D'ASARO, F.
Estimation of the Time Scale of the Geomorphologic Instantaneous Unit Hydrograph from Effective Streamflow Velocity,
W89-00704 2E

DA MOTTA MARQUES, D. M. L.
Review of the Behaviour and Utilization of Polycarboxylic Acids as Detergent Builders,
W89-00620 5D

DABORN, G. R.
Adventures in Holistic Ecosystem Modelling: The Cumberland Basin Ecosystem Model,
W89-00675 2L

DABROWSKA, H.
Acute Toxicity of Ammonia to Common Carp (Cyprinus carpio L.),
W89-00244 5C

DAEMEN, E. A. M. J.
Comparison of Methods for the Determination of Chlorophyll in Estuarine Sediments,
W89-00668 2L

DAGAN, G.
Time-Dependent Macrodispersion for Solute Transport in Anisotropic Heterogeneous Aquifers,
W89-01245 2F

DAHAB, M. F.
Nitrate Removal from Water Supplies Using Biological Denitrification,
W89-01237 5F

Systems Approach to Nitrate Removal from Groundwater Supplies,
W89-00134 5F

DAIGNAULT, S. A.
Review of the Use of XAD Resins to Concentrate Organic Compounds in Water,
W89-01215 5A

DAMEZ, F.
Optimization of the Production and Pumping Costs of the Nice Water Network (Optimisation de la Production et des Pompages sur le Reseau d'Eau de Nice),
W89-00922 5F

DAMSLETH, E.
Parametric and Nonparametric Tests for Dependent Data,
W89-00864 7C

DANA, M. T.
Acidic Deposition Distribution and Episode Statistics from the MAP3S Network Database,
W89-01151 5B

DANDEKAR, Y. S.
Planning and Construction of the Pahalgam Scheme,
W89-01004 8A

DANGLER, H. W.
Sierra Club v. Block, Wilderness Water Rights Protected Where Not in Conflict with Purposes of National Forest in Colorado,
W89-00522 6E

DANIEL, D. E.
Interaction of Earthen Liner Materials with Industrial Waste Leachate,
W89-00997 5E

DARLING, W. G.
Stable Isotope Study of Recharge Processes in the English Chalk,
W89-01197 2F

DARMOIAN, S. A.
Sediments in the Estuarine Environment of the Tigris/Euphrates Delta; Iraq; Arabian Gulf,
W89-01083 2L

DARWISH, M. A.
Cogeneration Power Desalination Plants,
W89-01064 3A

DATE, Y.
Nitrogen Metabolism in the Brackish Lake Nakanoumi. III. Nitrification-Dentrification in Low Concentration of Dissolved Oxygen, (in Japanese),
W89-00769 2H

DAUBLE, D. D.
Avoidance of a Water-Soluble Fraction of Coal Liquid by Fathead Minnows,
W89-00321 5C

DAVID, J. S.
Runoff Generation in a Plough-drained Peat Bog in Southern Scotland,
W89-00345 4C

DAVIES, I. M.
Marine Pollution in Orkney,
W89-00796 5G

DAVIES, J. M.
Monitoring the Moray Firth Environment,
W89-00787 5C

DAVIES, R. W.
Effects of a Simulated Acid Precipitation on Leaf Litter Quality and the Growth of a Detritivore in a Buffered Lotic System,
W89-01058 5C

DAVIS, G. J.
Biomass Production and Nutrient Cycling in Aquatic Macrophyte Communities of the Chowan River, North Carolina,
W89-00097 2H

DAVIS, P.
Interannual Variability in Climate and Fisheries in Tasmania,
W89-00847 2A

DAVISON, W.
Internal Elemental Cycles Affecting the Long-Term Alkalinity Status of Lakes: Implications for Lake Restoration,
W89-00016 5G

DAVOLI, E.
Analysis of Atrazine in Underground Waters at Part Per Trillion Levels as an Early Warning Method for Contamination and for Soil Distribution Studies,
W89-00596 5A

DAY, J. W.
Effects of River Discharge and Vertical Circulation on Aquatic Primary Production in a Turbid Louisiana (USA) Estuary,
W89-00005 2L

DAY, M. J.
Contribution of Plasmids to Naphthalene Catabolism in Sediment Bacteria,
W89-00378 5B

DE ARAMBARRI, P.
Heavy Metal Pollution in the Guadiamar River and the Guadalquivir Estuary (South West Spain),
W89-00573 5B

DE DECKER, H. P.
Benthic Macrofauna of the Bot River Estuary, South Africa, with a Note on Its Meiofauna,
W89-00660 2L

Comparison of the Physiological Condition of the Southern Mullet Liza richardsoni (Smith), in a Closed Estuary and the Sea,
W89-00663 2L

Synopsis of the Impact of Artificially Opening the Mouth of the Bot River Estuary: Implications for Management,
W89-00666 2L

DE GROSBOIS, E.
Assessing the Birkenes Model of Stream Acidification Using a Multisignal Calibration Methodology,
W89-00974 7B

Multisignal Automatic Calibration Methodology for Hydrochemical Models: A Case Study of the Birkenes Model,
W89-00973 5B

DE GUIA, M. B.
Carbon Source of the Water Soldier, Stratiotes aloides L.,
W89-00128 2H

DE LA CRUZ, A. A.
Tropical Wetlands as a Carbon Source,
W89-00118 2H

DE MOLENAAR, J. G.
Ecohydrological Approach to Floral and Vegetational Patterns in Arctic Landscape Ecology,
W89-00435 2H

DE RUYTER VAN STEVENINCK, E. D.
Population Dynamics of a Tropical Intertidal and Deep-Water Population of Sargassum polyceratium (Phaeophyceae),
W89-00528 2L

DE SOUSA, F.
Fate of Spent Bleach Liquor Material in Receiving Waters: Characterization of Chloroorganics in Sediments,
W89-00371 5B

DEACON, J. E.
Endangered Woundfin and Water Management in the Virgin River, Utah, Arizona, Nevada,
W89-00311 6G

DEANGELIS, D. L.
Potential Importance of Spatial and Temporal Heterogeneity in pH, Al, and Ca in Allowing Survival of a Fish Population: A Model Demonstration,
W89-01052 5C

DEASON, E. A.
Nitrogen Dynamics in Lower Narragansett Bay: II. Phytoplankton Uptake, Depletion Rates of Nitrogenous Nutrient Pools, and Estimates of Ecosystem Remineralization,
W89-00215 2L

DEBARTOLOMEO, A.
Definition of a Model for Monitoring the Chemical and Chemical-Physical Characteristics of Deep Drinking Waters,
W89-00927 7C

DEBECKER, E.
Nitrogen Budget of the Scheldt Hydrographical Basin,
W89-00155 5B

DECOSTA, J.
Effects of Acidification and Phosphorus Addition on Phytoplankton Biomass and Productivity in a Circum-Neutral Mesotrophic Lake Receiving Acid Precipitation,
W89-00179 2H

DEDUN, S.
Application of Probability Weighted Moments in Estimating the Parameters of the Pearson Type Three Distribution,
W89-01198 7C

DEFLAUN, M. F.
Mechanisms of DNA Utilization by Estuarine Microbial Populations,
W89-00340 2L

DEGENS, E. T.
Ca(+2)-Stress, Biological Response and Particle Aggregation in the Aquatic Habitat,
W89-00669 2K

DEHNAD, F.
Influence of Selected Organic Complexing Agents on the Sorption of Heavy Metals in River Sediments (Einfluss Ausgewaehlter Organischer Komplexbildner auf die Sorption von Schwermetallen an Gewaessersedimente),
W89-00501 5B

DEINEMA, M. H.
Effect of Environmental Conditions on the Occurrence of Microthrix parvicella in Activated Sludge,
W89-01217 5D

DEJAK, M.
Copper, Nickel, and Chrome Recovery in a Jobshop to Eliminate Waste Treatment and Sludge Disposal,
W89-00993 5D

DEL CORRAL, J.C.
Comparisons of RADM and Oscar Precipitation Chemistry Data,
W89-00433 5B

DELEON, I. R.
Contributions of Heavy Metals from Municipal Runoff to the Sediments of Lake Pontchartrain, Louisiana,
W89-00618 5B

DELL'UOMO, A.
Diatoms and Other Algae from the Thermal-Sulphur Springs of Triponzo (Central Italy),
W89-00190 2H

DELRIEU, G.
Rain Measurement by Raingage-Radar Combination: A Geostatistical Approach,
W89-00761 7B

DEMARCO, J.
GAC Treatment Cost Experience at Two Drinking Water Utilities,
W89-00495 5F

DEMERS, L. D.
Design Considerations for Package Water Treatment Systems,
W89-01117 5F

DEMISSIE, M.
Long-Term Ecological Research on Illinois Rivers,
W89-00401 2H

Scour Channel Development after Spillway Failure,
W89-00897 2J

DEMOTT, W. R.
Discrimination between Algae and Artificial Particles by Freshwater and Marine Copepods,
W89-01047 2H

DEN HARTOG, C.
Ammonium and Nitrate Uptake by Aquatic Plants from Poorly Buffered and Acidified Waters,
W89-00112 5C

DEPINTO, J. V.
Drainage Basin Control of Acid Loadings to Two Adirondack Lakes,
W89-00710 5B

Factors Affecting the Efficiency of Some Estimates of Fluvial Total Phosphorus Load,
W89-01249 5B

DESAI, A. K.
Biochemical Changes in the Liver of Fish, Tilapia mossambica (Peters), during Continuous Exposure to Monocrotophos,
W89-00085 5C

DETHLEFSEN, V.
Developmental Defects in Pelagic Fish Embryos from the Western Baltic,
W89-00315 5C

DETOURNAY, C.
New Approximate Technique for the Hodograph Method in Groundwater Flow and Its Application to Coastal Aquifers,
W89-01243 2F

DEVAI, G.
New Aspects of the Sulfur Cycle, with Special Reference to Shallow Waters,
W89-00183 5B

DEVAI, I.
New Aspects of the Sulfur Cycle, with Special Reference to Shallow Waters,
W89-00183 5B

DEVILLERS, J.
Predictive Structure-Toxicity Model with Daphnia magna,
W89-00591 5C

DEVRIES, R. T. P.
Dynamics of Dissolved Silicium and Nitrogen-Nutrients at Low Temperature in the EMS-Dollard Estuary,
W89-00673 2L

DEWOLF, L.
Effects on the Benthic Fauna of Embanking an Intertidal Flat Area (The Markiezaat, Eastern Scheldt Estuary, The Netherlands),
W89-00676 6G

DIAMOND, J. T.
Planning Indiana's Water Infrastructure from a Competitive Perspective,
W89-00880 6B

DIAZ-DIAZ, G.
Size Distribution and Copper Association of Dissolved Organic Material in Urban Runoff,
W89-00628 5B

DICENZO, P.
Pipe Flow in James Bay Coastal Wetlands,
W89-00047 2A

DICK, R. I.
Compressible Cake Filtration: Monitoring Cake Formation and Shrinkage Using Synchrotron X-rays,
W89-00512 5D

DICKENS, W. J.
London Water Ring Main,
W89-00840 5F

DIGIANO, F.
Coping with Groundwater Contamination,
W89-01135 5G

DIGIANO, F. A.
Determination of Microbial Kinetic Coefficients through Measurement of Initial Rates by Radiochemical Techniques,
W89-01218 5D

DILLAHA, T. A.
Evaluation of Vegetation Filter Strips as a Best Management Practice for Feed Lots,
W89-01125 5G

Water Management for Lowland Rice Irrigation,
W89-00750 3F

DILLON, P. J.
Effects of Acidification on Metal Budgets of Lakes and Catchments,
W89-00207 5C

Effects of Sulphur Deposition on Lake-Water Chemistry in Ontario, Canada,
W89-00846 5B

DIMENT, G.
General Water Supply System Simulation Model: WASP,
W89-00299 5F

DIXON, D. G.
Estimating the Acute Toxicity of Waterborne Chemicals in Trout from Measurements of Median Lethal Dose and the Octanol-Water Partition Coefficient,
W89-01095 5C

DIXON, K. L.
Occurrence of Radon in Well Supplies,
W89-01105 5B

DMITRIEV, N. V.
Characteristics of the Organization and Performance of Works in the Dam Foundation of the Al-Hadithah Hydro Development (Iraq),
W89-01182 8F

DOBBINS, D. C.
Aerobic Biodegradation of Natural and Xenobiotic Organic Compounds By Subsurface Microbial Communities,
W89-01090 5B

DOBBS, R. A.
Removal of Organic Toxic Pollutants by Trickling Filter and Activated Sludge,
W89-01133 5D

DOBLER, E.
Seasonal Changes of Phytoplankton in the Backwater Bokros,
W89-00147 2H

DOHERTY, F. G.
Metallothionein-Like Heavy Metal Binding Protein Levels in Asiatic Clams Are Dependent on the Duration and Mode of Exposure to Cadmium,
W89-01228 5B

DOLLARD, G. J.
Field Study of the Cloud Chemistry and Cloud Microphysics at Great Dun Fell,
W89-00308 5B

DOLLOFF, C. A.
Effects of Stream Cleaning on Juvenile Coho Salmon and Dolly Varden in Southeast Alaska,
W89-00374 2H

DOMASCHUK, L.
Creep of Ice Measured with the Pressuremeter,
W89-00387 2C

DONEAUD, A. A.
Modified ATI Technique for Nowcasting Convective Rain Volumes over Areas,
W89-00090 2B

DONNELLY, K. C.
Estimation of the Risk Associated with the Organic Constituents of Hazardous and Municipal Waste Landfill Leachates,
W89-00995 5B

DONNERMEYER, G. N.
Biomass and Nutritive Potential of Vallisneria americana Michx in Navigation Pool 9 of the Upper Mississippi River,
W89-00093 2H

DOODY, J. P.
Saltmarshes of the Firth of Clyde,
W89-00830 2L

DORAN, D. G.
Problems of Rainfall-Runoff Modelling in Arid and Semiarid Regions,
W89-01144 2E

DORGHAM, M. M.
Environmental Conditions in Abu Kir Bay, East of Alexandria: I. Physico-chemical Characteristics and Water Circulation,
W89-00565 5B

Environmental Conditions in Abu Kir Bay, East of Alexandria: II. Plankton Distribution, Downstream from Land-Based Effluents,
W89-00578 5C

DORN, P. B.
Degradation of Bisphenol A in Natural Waters,
W89-00600 5B

DOTY, R. N.
New Regulations: A Challenge for Small Systems,
W89-01118 5F

DOUGHTY, C. R.
Migratory Salmonids of the Estuary and Firth of Clyde,
W89-00828 5G

DOUGLAS, J. R.
Regulating the River Severn,
W89-00954 4A

DOWLER, N. A.
Formation of Hydrous Zirconium (IV) Oxide Polyelectrolyte Membranes, I. Poly (itaconic acid) and Poly (acrylic-co-itaconic acid),
W89-01062 3A

DOWNING, J. A.
Spatial Patchiness in the Lacustrine Sedimentary Environment,
W89-01048 2H

DRAKE, L.
Regional Hydrogeology of Agricultural Drainage Wells in Iowa,
W89-00471 5B

DREHER, W.
Degradation of Polycyclic Aromatic Hydrocarbons: III. Reaction Products of the Ozonolysis of Further Polycyclic Aromatic Hydrocarbons in Aqueous Systems (Zum Abbau von Polycyclischen Aromatischen Kohlenwasserstoffen: III. Reaktionsprodukte der Umsetzung von Weiteren Polycyclischen Aromatischen Kohlenwasserstoffen in Wasser mit Ozon),
W89-00739 5F

DREVENKAR, V.
Polychlorinated Biphenyls in the Kupa River, Croatia, Yugoslavia,
W89-00609 5B

DRISCOLL, C. T.
Soil Processes and Sulfate Loss at the Hubbard Brook Experimental Forest,
W89-00206 5B

DRISCOLL, J. N.
Analysis of ppb Levels of Organics in Water by Means of Purge-and-Trap, Capillary Gas Chromatography and Selective Detectors,
W89-00288 5A

DRONKERS, J.
Experimental Determination of Salt Intrusion Mechanisms in the Volkerak Estuary,
W89-00667 2L

Tidal Asymmetry and Estuarine Morphology,
W89-00670 2L

DRUDE DE LACERDA, L.
Mercury Inputs into the Amazon Region, Brazil,
W89-00637 5B

DUAN, Q.
Maximum Likelihood Criterion for Use With Data Collected at Unequal Time Intervals,
W89-00723 2E

DUBINSKY, Z.
Measurement of Primary Productivity in a High-Rate Oxidation Pond (HROP),
W89-00213 2H

DUCAUZE, C.
Use of Factorial Experimental Design to Evaluate How Biotic and Abiotic Factors Influence Cadmium Accumulation in the Unicellular Alga Dunaliella bioculata,
W89-01043 5B

DUCKSTEIN, L.
Multicriterion Selection of Wastewater Management Alternatives,
W89-00300 5D

DUDLEY, W. C.
Distribution of Arsenic in the Sediments and Biota of Hilo Bay, Hawaii,
W89-00677 5B

DUFFY, M.
Analysis of ppb Levels of Organics in Water by Means of Purge-and-Trap, Capillary Gas Chromatography and Selective Detectors,
W89-00288 5A

DUGUET, J. P.
Chloropicrin in Potable Water: Conditions of Formation and Production during Treatment Processes (La Chloropicrine dans les Eaux Potables: Conditions de Formation et Evolution le long des Filieres de Traitement),
W89-00635 5F

DUINKER, J. C.
River Ems: Processes Affecting the Behaviour of Metals and Organochlorines during Estuarine Mixing,
W89-00149 5B

DUNN, I. J.
Operation of a Three-Phase Biofilm Fluidized Sand Bed Reactor for Aerobic Wastewater Treatment,
W89-00747 5D

DUNNING, H. C.
State Equitable Apportionment of Western Water Resources,
W89-01267 6E

DUPRIEZ, G. L.
Repercussions of a CO2 Doubling on the Water Cycle and on the Water Balance - A Case Study for Belgium,
W89-00355 2A

DURAND, R.
Risk: A Key Water Policy Issue,
W89-01123 6D

DURVE, V. S.
Study of the Temperature Dependence of the Acute Toxicity of Pentachlorophenol to a Freshwater Pond Snail, Viviparus bengalensis L.,
W89-00078 5C

DUTKA, B. J.
Incidence of Coliphage in Potable Water Supplies,
W89-00338 5F

DUURSMA, E. K.
Partitioning of Organochlorines Between Water, Particulate Matter and Some Organisms in Estuarine and Marine Systems of the Netherlands,
W89-00672 5B

DWORKIN, J. M.
Effects of Rate Structure Knowledge on Household Water Use,
W89-00877 6D

DWYER, F. J.
Sensitivity of Young Striped Bass to Organic and Inorganic Contaminants in Fresh and Saline Waters,
W89-00320 5C

DZIDIC, I.
Determination of Naphthenic Acids in California Crudes and Refinery Wastewaters by Fluoride Ion Chemical Ionization Mass Spectrometry,
W89-00209 5A

EAGLESON, P. S.
Evaluation of a Homogeneous Point Process Description of Arizona Thunderstorm Rainfall,
W89-00724 2B

EASTER, K. W.
Ex Post Analysis of Flood Control: Benefit-Cost Analysis and the Value of Information,
W89-00983 6C

EATON, H.
Effects of Three Organics on Selected Physical Properties of Type I Portland Cement,
W89-00994 5E

EATON, H. C.
Transmission Electron Microscopic Study of Solidified/Stabilized Organics,
W89-01000 5E

ECCLES, C. R.
Isolation, Identification and Characterisation of Filamentous and Floc-Forming Bacteria from Activated Sludge Flocs,
W89-00648 5D

EDBERG, S. C.
National Field Evaluation of a Defined Substrate Method for the Simultaneous Enumeration of Total Coliforms and Escherichia coli from Drinking Water: Comparison with the Standard Multiple Tube Fermentation Method,
W89-00337 5A

EDER, G.
Chlorinated Hydrocarbons in Sediments of the Elbe River and the Elbe Estuary,
W89-00614 5B

EDGERTON, S. A.
Hydrocarbon Fuel Spill Dispersion on Water: A Literature Review,
W89-00598 5B

EDWARDS, A.
Clyde Sea Hydrography,
W89-00802 2L

EGBORGE, A. B. M.
Rotifers of Warri River, Nigeria,
W89-00222 2H

EGOROVA, L. G.
Some Results of Investigating the State of the Powerhouse of the Plyavinyas Hydroelectric Station,
W89-01180 8D

EHEART, J. W.
Cost Efficiency of Transferable Discharge Permit Markets for Control of Multiple Pollutants,
W89-00697 5G

EIDELMAN, I. J.
Legionnaire's Disease in a Johannesburg Teaching Hospital,
W89-00450 5F

EILERS, J. M.
Alkalinity Regulation in Softwater Florida Lakes,
W89-00714 2H

EISMA, D.
Flocculation and De-Flocculation of Suspended Matter in Estuaries,
W89-00671 2L

EKAMA, G. A.
STASOFT: A User-Friendly Interactive Computer Program for Softening and Stabilisation of Municipal Waters,
W89-00935 5F

EL-ABAGY, M. M.
Incidence of Coliphage in Potable Water Supplies,
W89-00338 5F

EL-GAMAL, I. M.
Studies on the Degradation of Synthetic Detergents by Sewage,
W89-01159 5B

EL GHOBARY, H.
Interpretation of Metal Profiles in a Sediment Core from Lake Geneva: Metal Mobility or Pollution,
W89-00694 5B

EL-GOHARY, F. A.
Treatability Studies of Textile Wastewater,
W89-00627 5D

EL-SHAARAWI, A. H.
Parametric and Nonparametric Tests for Dependent Data,
W89-00864 7C

ELEFTHERIADIS, I.
Treatment of Dye-Containing Effluents with Different Bentonites,
W89-00615 5D

ELEFTHERIOU, A.
Benthic Fauna of Sandy Bays, with Particular Reference to Irvine Bay,
W89-00819 5C

ELLENTON, G.
Relative Roles of Emissions Changes and Meteorological Variability of Wet sulfur Deposition: A Trajectory Model Study,
W89-01259 5B

ELLERY, K.
Roles of Sedimentation and Plant Growth in Changing Flow Patterns in the Okavango Delta, Botswana,
W89-00457 2J

ELLERY, W. N.
Roles of Sedimentation and Plant Growth in Changing Flow Patterns in the Okavango Delta, Botswana,
W89-00457 2J

ELLETT, D. J.
Clyde Sea Hydrography,
W89-00802 2L

ELLIOT, S.
Citizen Suits under the Clean Water Act: Waiting for Godot in the Fifth Circuit,
W89-00517 6E

ELLIOTT, J. E.
Organochlorines and Eggshell Thinning in Northern Gannets (Sula bassanus) from Eastern Canada, 1968-1984,
W89-01054 5C

ELLIOTT, S. T.
Reduction of a Dolly Varden Population and Macrobenthos after Removal of Logging Debris,
W89-00322 4C

ELMGREN, R.
Response of Benthic Meiofauna to Nutrient Enrichment of Experimental Marine Ecosystems,
W89-01033 5C

ELORANTA, P.
Hypolimnetic Chlorophyll Maximum by Algae and Sulphur Bacteria in one Eutrophic Pond,
W89-00012 2H

EMEL, J. L.
Groundwater Rights: Definition and Transfer,
W89-00838 6E

EPIFANIO, C. E.
Dispersal and Recruitment of Fiddler Crab Larvae in the Delaware River Estuary,
W89-01039 2L

ERALP, A. E.
Removal of Organic Toxic Pollutants by Trickling Filter and Activated Sludge,
W89-01133 5D

ERISMAN, J.
Wet Deposition of Ammonium in Europe,
W89-00765 2B

ERLAP, A. E.
Influence of Feeding Procedure on Microbial Reductions and Performance of Anaerobic Digestion,
W89-00511 5D

ERMAN, D. C.
Effects of Discharge Fluctuation and the Addition of Fine Sediment on Stream Fish and Macroinvertebrates Below a Water-Filtration Facility,
W89-01061 5C

ERNST, W.
Chlorinated Hydrocarbons in Sediments of the Elbe River and the Elbe Estuary,
W89-00614 5B

ERTL, M.
Effect of the Hydrological Regime on Primary Production in the Main Stream and the Side Arms of the River Danube,
W89-00162 2H

ESHLEMAN, K. N.
Predicting Regional Episodic Acidification of Surface Waters Using Empirical Models,
W89-00719 5B

ESHO, R. T.
Algal Studies of the River Ely, South Wales, U.K.: I. Phytoplankton,
W89-00678 2H

Algal Studies of the River Ely, South Wales, U.K.: II. Epilithic Algae,
W89-00679 2H

ESLING, S.
Regional Hydrogeology of Agricultural Drainage Wells in Iowa,
W89-00471 5B

ESSINK, K.
Monitoring of Mercury Pollution in Dutch Coastal Waters by Means of the Teleostean Fish Zoarces Viviparus,
W89-00150 5C

ESTEP, K. W.
Phagotrophic Phototrophs: The Ecological Significance of Mixotrophy,
W89-00384 2H

EVANS, D. W.
Effect of pH and Contact Time on the Concentration of As(III) and As(V) in Coal Ash Systems,
W89-00624 5E

EVANS, H. E.
Effects of Acidification on Metal Budgets of Lakes and Catchments,
W89-00207 5C

EVEREST, F. H.
Physiological Effects on Coho Salmon and Steelhead of Exposure to Suspended Solids,
W89-00292 5C

EVERETT, K. R.
Productivity and Nutrient Cycling of Alaskan Tundra: Enhancement by Flowing Soil Water,
W89-00908 2G

EWALD, M.
High Resolution Emission Spectroscopy (Shpol'skii Effect): A New Analytical Technique for the Analysis of Polycyclic Aromatic Hydrocarbons (PAH) in the Environmental Samples,
W89-00574 5A

FAGGELLA, G. A.
Comparison of Laboratory and Field Observations of Fish Exposed to the Herbicides Molinate and Thiobencarb,
W89-00376 5C

FAILLA, M. L.
Metallothionein-Like Heavy Metal Binding Protein Levels in Asiatic Clams Are Dependent on the Duration and Mode of Exposure to Cadmium,
W89-01228 5B

FAIRCHILD, G. W.
Periphyton, Benthic Invertebrates and Fishes as Biological Indicators of Water Quality in the East Branch Brandywine Creek,
W89-00314 5A

FAITH, D. P.
Landscape and Rainfall Indices for Prediction of Streamflow Similarities in the Hunter Valley, Australia,
W89-00972 2E

FAIZIEV, K.
Use of Horizontal Drainage for Draining Dam Slopes,
W89-00040 8C

FANAKI, F. H.
Field Measurements of Water-Air Exchange of Mercury in Freshwater Systems,
W89-00640 5A

FANELLI, R.
Analysis of Atrazine in Underground Waters at Part Per Trillion Levels as an Early Warning Method for Contamination and for Soil Distribution Studies,
W89-00596 5A

FARMER, A. M.
Effects of Light and Temperature on Photosynthesis of the Nuisance Alga Cladophora glomerata (L.) Kutz from Green Bay, Lake Michigan,
W89-00848 2H

Growth Strategies and Distribution of Isoetids in Scottish Freshwater Lochs,
W89-00129 5C

FAROOQ, S.
High Level Disinfection of Wastewaters for Reuse,
W89-00642 5D

FARRAH, S. R.
Novel Approach for Modifying Microporous Filters for Virus Concentration from Water,
W89-00332 5A

FARRELL, J. B.
Influence of Feeding Procedure on Microbial Reductions and Performance of Anaerobic Digestion,
W89-00511 5D

FARRINGTON, J. W.
Biogeochemistry of Benz(a)anthracene at the Sediment-Water Interface,
W89-00612 5B

FARRISH, K. W.
Decomposition in an Ombrotrophic Bog and a Minerotrophic Fen in Minnesota,
W89-00742 2H

FATTAL, B.
Association Between Seawater Pollution as Measured by Bacterial Indicators and Morbidity Among Bathers at Mediterranean Bathing Beaches of Israel,
W89-00579 5C

FAUSCH, K. D.
Spatial and Temporal Variability of the Index of Biotic Integrity in Three Midwestern Streams,
W89-00026 2E

FAVARGER, P. Y.
Interpretation of Metal Profiles in a Sediment Core from Lake Geneva: Metal Mobility or Pollution,
W89-00694 5B

FAVERO, M. S.
Efficacy of Chemical Dosing Methods for Isolating Nontuberculous Mycobacteria from Water Supplies of Dialysis Centers,
W89-00343 5A

FAYYAD, M.
Indirect Trace Determination of Ethylenediaminetetraacetic Acid (EDTA) in Water by Potentiometric Stripping Analysis,
W89-00481 5A

FECHTER, H.
Iron Oxide Formation in Artificial Ground Waters,
W89-00687 2F

FEDDES, R. A.
Modelling Soil Water Dynamics in the Unsaturated Zone: State of the Art,
W89-01014 2G

FEDEROV, E. A.
Possibility of Using Radioactively Polluted Waterbodies for Fish Culture,
W89-01193 3C

FELTON, J.
Effects of Organic Contaminants on Reproduction of the Starry Flounder Platichthys stellatus in San Francisco Bay. I. Hepatic Contamination and Mixed-Function Oxidase (MFO) Activity During the Reproductive Season,
W89-00385 5C

FENGSHU, L.
Numerical Simulation on Typhoon Surge and Surge Estimation of Huanghe River Estuary Region in Bohai Sea, (in Chinese),
W89-00543 2L

FERGUSON, J. F.
Effects of Cyanide and Polyphosphates on Adsorption of Metals from Simulated and Real Mixed-Metal Plating Wastes,
W89-01219 5D

FERLEY, J. P.
Comparison of Bacterial Indicators and Sampling Programs for Drinking Water Systems,
W89-00733 5A

FERRARA, A.
Sorption and Desorption Dynamics of Aroclor 1242 to Natural Sediment,
W89-00991 5B

FERRARA, O.
Zooplankton Population of Man-Made Lakes in Abruzzi's Appennines: Campotosto Lake (Popolamento Zooplanctonico di un Lago di Sbarramento Dell'Appennino Abruzzese: Il Lago di Campotosto),
W89-00197 2H

FERRARI, I.
Trophic State Gradients and Zooplankton and Zoobenthos Distribution in a Po River Delta Lagoon,
W89-00580 2L

FERRONI, G. D.
Statistical Considerations Associated with the Use of the Heterotrophic Activity Method for Estimating V sub max and K' for Aquatic Environments,
W89-00280 7C

FETCHER, N.
Productivity and Nutrient Cycling of Alaskan Tundra: Enhancement by Flowing Soil Water,
W89-00908 2G

FEVOLDEN, S. E.
Population Genetics of Mytilus edulis (L.) from Oslofjorden, Norway in Oil-Polluted and Non Oil-Polluted Water,
W89-01009 5C

FIKSDAL, L.
Rapid Detection of Total and Fecal Coliforms in Water by Enzymatic Hydrolysis of 4-Methylumbelliferone-beta-D-Galactoside,
W89-00734 5A

FILIP'EV, A. A.
Effective Coatings for Hydraulic Structures,
W89-00075 8G

FILOSO, S.
Nutrient Release Through Decomposition of Diplodon Delodontus Expansus (Mollusca, Bivalvia) and Some Considerations of its Effects on the Ecology of a Small Tropical Reservoir,
W89-00009 2H

FINDLAY, S.
Bacterial Production in Fresh and Saltwater Ecosystems: A Cross-System Overview,
W89-01034 2H

FINLAYSON, B. J.
Comparison of Laboratory and Field Observations of Fish Exposed to the Herbicides Molinate and Thiobencarb,
W89-00376 5C

FINN, J. T.
Streamflow Regulation and Fish Community Structure,
W89-01053 4A

FISHER, T. R.
Nitrate and Ammonium Uptake by Plankton in an Amazon River Floodplain Lake,
W89-00229 2H

Regeneration and Uptake of Ammonium by Plankton in an Amazon Floodplain Lake,
W89-00230 2H

FISZMAN, M.
Heavy Metal Removal by Different Water Treatment Plants, in Rio de Janeiro State, Brazil,
W89-00647 5F

FLERCHINGER, G. N.
Explicit Solution to Green-Ampt Equation for Nonuniform Soils,
W89-00760 7B

FLETCHER, R. I.
Risk Analysis for Fish Diversion Experiments: Pumped Intake Systems,
W89-00318 8I

FLOISTAD, B.
Sea Use Planning in Norwegian Waters: National and International Dimensions,
W89-00289 6E

FLORES MUNOZ, G.
Mercury in Freshwater Fish and Clams from the Cerro Prieto Geothermal Field of Baja California, Mexico,
W89-01153 5B

FLORIO, R.
Water Rights: Enforcing the Federal-Indian Trust after Nevada v. United States,
W89-01010 6E

FOCARDI, S.
Variations in Polychlorinated Biphenyl Congener Composition in Eggs of Mediterranean Water Birds in Relation to their Position in the Food Chain,
W89-01056 5B

FOERSTNER, U.
Influence of Selected Organic Complexing Agents on the Sorption of Heavy Metals in River Sediments (Einfluss Ausgewaehlter Organischer Komplexbildner auf die Sorption von Schwermetallen an Gewaessersedimente),
W89-00501 5B

FOGDEN, A.
Contaminant Transport in Fractured Porous Media: Steady State Solutions by a Boundary Integral Method,
W89-00982 5B

FOGEL, M.
Multicriterion Selection of Wastewater Management Alternatives,
W89-00300 5D

FOLEY, R. E.
Organochlorine and Mercury Residues in Wild Mink and Otter: Comparison with Fish,
W89-01093 5B

FONTAINE, R. E.
Guinea Worm Disease in Northern Uganda: A Major Public Health Problem Controllable Through an Effective Water Programme,
W89-00278 5F

FORBES, D. L.
System for Coastal Description and Classification,
W89-01071 7C

FORLIN, L.
Physiological Disturbances in Fish Exposed to Bleached Kraft Mill Effluents,
W89-00363 5C

FORSBERG, C.
Evaluation of Lake Restoration in Sweden,
W89-00021 5G

Photosynthesis of Submersed Macrophytes in Acidified Lakes: II. Carbon Limitation and Utilization of Benthic CO2 Sources,
W89-00095 5C

FORSTER, C.
Groundwater Flow Systems in Mountainous Terrain: 1. Numerical Modeling Technique,
W89-00708 2F

Groundwater Flow Systems in Mountainous Terrain: 2. Controlling Factors,
W89-00709 2F

FOSSI, C.
Variations in Polychlorinated Biphenyl Congener Composition in Eggs of Mediterranean Water Birds in Relation to their Position in the Food Chain,
W89-01056 5B

FOTIEVA, N. N.
Calculation of Pressure Tunnel Linings with Consideration of Consolidation Grouting of the Rocks,
W89-00547 8C

FOUFOULA-GEORGIOU, E.
Gradient Dynamic Programming for Stochastic Optimal Control of Multidimensional Water Resources Systems,
W89-00979 6A

FOUQUART, Y.
Comparison of Model-Generated and Satellite-derived Cloud Cover and Radiation Budget,
W89-01262 2A

FOWLER, D.
Influence of Altitude on Rainfall Composition at Great Dun Fell,
W89-01146 5B

Influence of Altitude on Wet Deposition: Comparison between Field Measurements at Great Dun Fell and the Predictions of a Seeder-Feeder Model,
W89-01147 5B

FOX, L. E.
Solubility of Colloidal Ferric Hydroxide and its Relevance to Iron Concentrations in River Water,
W89-01081 2K

FRADKIN, B. V.
Calculation of an Arch Dam on the Basis of Solving the Three-dimensional Problem of the Theory of Elasticity and Theory of Shells,
W89-00057 8A

FRALEIGH, P. C.
Myxococcal Predation on Cyanobacterial Populations: Nutrient Effects,
W89-01050 2H

FRANCOIS, R. J.
Growth Kinetics of Hydroxide Flocs,
W89-00428 5F

FRANCONI, U.
Definition of a Model for Monitoring the Chemical and Chemical-Physical Characteristics of Deep Drinking Waters,
W89-00927 7C

FRANSZ, H. G.
Modelling Research on the Production Cycle of Phytoplankton in the Southern Bight of the North Sea in Relation to Riverborne Nutrient Loads,
W89-00157 2L

FRECH, T.
Monitoring of Liquid Effluents as Preventative Protection of Natural Bodies of Water (Abwasseruberwachung als vorbeugender Gewasserschutz),
W89-01184 5G

FREDLUND, D. G.
Modelling of Flow Through Potash Tailings Piles,
W89-00388 5B

FREEDMAN, D.
Influence of Feeding Procedure on Microbial Reductions and Performance of Anaerobic Digestion,
W89-00511 5D

FREI, R. W.
Determination of Polychlorinated Dibenzofurans in Surface Water by Means of Liquid Chromatography Using on-Line Sample Preconcentration and Different Spectroscopic Detection Techniques,
W89-00590 5A

FRENCH, W.
Rural Community Assistance Program,
W89-01115 5F

FREVERT, T.
Can the Redox Conditions in Natural Waters be Predicted by a Single Parameter,
W89-00688 2K

FRICKER, A.
System for Coastal Description and Classification,
W89-01071 7C

FRICKERS, P. E.
Comparison of Nutrients in the Interstitial Water of Reducing (Tamar Estuary) and Oxic (Carmarthen Bay) Coastal Sediments,
W89-00156 2L

FRIMMEL, F. H.
Phosphorus Determination in Rivers (Phosphor in Fliessgewaessern und Seine Analytische Bestimmung),
W89-00735 5A

FROMME, G. A. W.
Hydrology of the Bot River Estuary,
W89-00654 2L

Synopsis of the Impact of Artificially Opening the Mouth of the Bot River Estuary: Implications for Management,
W89-00666 2L

FRYBERGER, S. G.
Stokes Surfaces and the Effects of Near-Surface Groundwater-Table on Aeolian Deposition,
W89-00410 2J

FRYE, R. S.
Drafting Water Quality Agreements,
W89-01253 6E

FUGIER, E. S.
How Safe is Your Water Plant,
W89-00462 5F

FUHRMAN, J. A.
Clearance of Bacteria-Sized Particles by Natural Populations of Nanoplankton in the Chesapeake Bay Outflow Plume,
W89-01032 2L

FUJIWARA, O.
River Basin Water Quality Management in Stochastic Environment,
W89-00490 5G

FUKUSHIMA, S.
Monitoring of PCDDs in Osaka Bay Using Blue Mussel,
W89-00604 5B

FULLER, I.
Attached Algae of the Clyde and Garnock Estuaries,
W89-00807 5C

FULTON, R.
Comparison of High-Altitude Remote Aircraft Measurements with the Radar Structure of an Oklahoma Thunderstorm: Implications for Precipitation Estimation from Space,
W89-00844 7B

FURLONG, E. T.
Accumulation of Polycyclic Aromatic Hydrocarbons in Acid Sensitive Lakes,
W89-01074 5B

FURNAS, M. J.
Nitrogen Dynamics in Lower Narragansett Bay: II. Phytoplankton Uptake, Depletion Rates of Nitrogenous Nutrient Pools, and Estimates of Ecosystem Remineralization,
W89-00215 2L

FURNESS, R. W.
Recent Changes in Numbers of Waders on the Clyde Estuary, and Their Significance for Conservation,
W89-00810 5C

FURSTENBERG, G.
Developmental Defects in Pelagic Fish Embryos from the Western Baltic,
W89-00315 5C

Toxicity of Sea-Surface Microlayer: Effects of Hexane Extract on Baltic Herring (Clupea harengus) and Atlantic Cod (Gadus morhua) Embryos,
W89-00856 5C

Toxicity of Sea-Surface Microlayer: Effects On Herring and Turbot Embryos,
W89-00855 5C

FYTIANOS, K.
Comparative Study of Heavy Metals Pollution in Various Rivers and Lakes of Northern Greece,
W89-00571 5B

FYTIANOS, K. K.
Correlation of Some Organic Pollution Factors in Water Systems in Northern Greece,
W89-00566 5B

GABRIELYAN, B. K.
Fecundity Dynamics of Khramulya, Varicorhinus capoeta sevangi, in Relation to the Changing Environment of Lake Sevan,
W89-01194 2H

GACHTER, R.
Lake Restoration: Why Oxygenation and Artificial Mixing Cannot Substitute for a Decrease in the External Phosphorus Loading,
W89-00015 5G

GAGNE, J. A.
Satellite Observations of Tidal Upwelling and Mixing in the St. Lawrence Estuary,
W89-00834 2L

GAIANI, V.
Trophic State Gradients and Zooplankton and Zoobenthos Distribution in a Po River Delta Lagoon,
W89-00580 2L

GAJIN, S.
Microbiological Examination of the Carska Bara Swamp Water,
W89-00146 2H

GALBRAITH, H.
Recent Changes in Numbers of Waders on the Clyde Estuary, and Their Significance for Conservation,
W89-00810 5C

GALEK, J.
Changes in Phytoplankton Over a Ten-Year Period in a Lake Undergoing De-Eutrophication due to Surrounding Peat Bogs,
W89-00196 2H

GALINATO, M. I.
Seed Germination Traits of Annuals and Emergents Recruited during Drawdowns in the Delta Marsh, Manitoba, Canada,
W89-00126 2H

GALLOWAY, J. N.
Local Influences on the Composition of Precipitation on Bermuda,
W89-00405 2A

GAMANN, D. E.
Microbial Characterization of Municipal Wastewater at a Spray Irrigation Site: the Lubbock Infection Surveillance Study,
W89-01124 7B

GAMBRELL, R. P.
Effects of High Levels of Polycyclic Aromatic Hydrocarbons on Sediment Physicochemical Properties and Benthic Organisms in a Polluted Stream,
W89-00589 5C

GAMIDOV, R. A.
Introduction of New Technology on the Construction of the Shamkhor Hydroelectric Station,
W89-00039 8A

GAMMON, J. R.
Longitudinal Changes in Fish Assemblages and Water Quality in the Willamette River, Oregon,
W89-00029 2H

GANDY, E. L.
Relationship between Nitrogen-Fixing Sulfate Reducers and Fermenters in Salt Marsh Sediments and Roots of Spartina alterniflora,
W89-00732 2L

GANGARDT, G. G.
Preservation of Natural Fish Reproduction during Hydrotechnical Construction on Rivers,
W89-00069 8I

GANTAR, M.
Microbiological Examination of the Carska Bara Swamp Water,
W89-00146 2H

GARCIA, A.
Urban Runoff Simulation Model,
W89-00301 2E

GARCIA-TELLO, P.
Effects of Oil Contamination on Colonization of Marine Periphytic Microflora,
W89-00681 5C

GARDEN, A.
Effects of a Simulated Acid Precipitation on Leaf Litter Quality and the Growth of a Detritivore in a Buffered Lotic System,
W89-01058 5C

GARDINER, J. L.
Environmentally Sound River Engineering Examples from the Thames Catchment,
W89-00962 4A

GARDNER, M. J.
Determination of Organotins in Natural Waters by Toluene Extraction and Graphite Furnace AAS,
W89-00743 5A

GARKUN, L. M.
Experience in Operating Hydraulic Structures and Equipment of Hydroelectric Stations,
W89-00554 8C

GARLAND, T. R.
Leaching of Retorted Oil Shale: Assessing the Toxicity to Colorado Squawfish, Fathead Minnows, and Two Food-Chain Organisms,
W89-00329 5C

GARNER, S.
Making the Most of Field-Measurable Ground Water Quality Parameters,
W89-00939 7B

GARNER, S. P.
Population Genetics of Mytilus edulis (L.) from Oslofjorden, Norway in Oil-Polluted and Non Oil-Polluted Water,
W89-01009 5C

GARRARD, W. N. C.
Instrumentation for 7-Day Continuous Cycle Monitoring of Metals with Automated On-Line Sample Preparation, High-Performance Liquid Chromatography, and Electrochemical Detection,
W89-00210 5A

GARRIGUES, P.
High Resolution Emission Spectroscopy (Shpol'skii Effect): A New Analytical Technique for the Analysis of Polycyclic Aromatic Hydrocarbons (PAH) in the Environmental Samples,
W89-00574 5A

GAUDETTE, H. E.
Trace Metal Geochemistry of Pore Water Brines from Two Hypersaline Lakes,
W89-01079 2K

GAY, M. J.
Field Study of the Cloud Chemistry and Cloud Microphysics at Great Dun Fell,
W89-00308 5B

Influence of Altitude on Rainfall Composition at Great Dun Fell,
W89-01146 5B

Influence of Altitude on Wet Deposition: Comparison between Field Measurements at Great Dun Fell and the Predictions of a Seeder-Feeder Model,
W89-01147 5B

GBUREK, W. J.
Chemical-Hydrologic Interactions in the Near-Stream Zone,
W89-00717 2E

GEBERT, J.
Evaluation of the Sulfur(IV) Catalyzed Autoxidation of Cobalt(II) in an Azide Containing Medium as a Means for the Determination of Sulfite in Precipitation,
W89-00736 5A

GEE, G. W.
Groundwater Recharge in Arid Regions: Review and Critique of Estimation Methods,
W89-00914 2F

GEISS, H.
Comparisons of RADM and Oscar Precipitation Chemistry Data,
W89-00433 5B

GELEYN, J. F.
Comparison of Model-Generated and Satellite-derived Cloud Cover and Radiation Budget,
W89-01262 2A

GELLENS, D.
Repercussions of a CO2 Doubling on the Water Cycle and on the Water Balance - A Case Study for Belgium,
W89-00355 2A

GELLER, A.
Degradation and Formation of Refractory DOM by Bacteria During Simultaneous Growth on Labile Substrates and Persistent Lake Water Constituents,
W89-00691 2H

GELLMAN, I.
Environmental Effects of Paper Industry Wastewaters: An Overview,
W89-00362 5C

GENTEMPO, J. J.
Degradation of Bisphenol A in Natural Waters,
W89-00600 5B

GEORGE, G. K.
Oxygen Transfer Through Flexible Tubing and Its Effects on Ground Water Sampling Results,
W89-00943 5A

GEORGE, R. J.
Role of Soil Organic Matter in the Geochemical Cycling of Chloride and Bromide,
W89-01200 2A

GERBA, C. P.
Microporous Filters with Oxidizing Power for Iron and Manganese Removal from Water,
W89-00889 5F

GERRITSE, R. G.
Role of Soil Organic Matter in the Geochemical Cycling of Chloride and Bromide,
W89-01200 2A

GESELBRACHT, J. J.
Issues in Rule Base Development,
W89-00305 6A

GEWARGIOUS, Y. A.
Determination of Traces of Bismuth in Water with Polyurethane Foam Thin-Layer Spectrophotometry,
W89-00482 5A

GEYER, W. R.
Shear Instability in a Highly Stratified Estuary,
W89-00415 2L

GHOBARAH, A.
Performance of Buried Small Pipes,
W89-00754 8A

GIBBS, N. L.
Use of Map Analysis to Elucidate Flooding in an Australian Riparian River Red Gum Forest,
W89-00722 2E

GIBSON, I. P.
Recent Changes in Numbers of Waders on the Clyde Estuary, and Their Significance for Conservation,
W89-00810 5C

GIBSON, J. A.
Recent Changes in the Status of Some Clyde Vertebrates,
W89-00826 5C

GIBSON, T. L.
Statistical Correlations for Predicting the Partition Coefficient for Nonpolar Organic Contaminants Between Aquifer Organic Carbon and Water,
W89-00992 5B

GIESY, J. P.
Comparison of Three Sediment Bioassay Methods Using Detroit River Sediments,
W89-01097 5A

Photo-induced Toxicity of Polycyclic Aromatic Hydrocarbons to Larvae of the Fathead Minnow (Pimephales promelas),
W89-00595 5C

GIGER, W.
Aliphatic and Polycyclic Aromatic Hydrocarbons in Urban Rain, Snow and Fog,
W89-00309 5B

Seasonal and Temporal Changes of Organic Compounds in Rain and Snow,
W89-00429 5B

GILES, D. M.
River Regulation by Seasonal Groundwater Abstraction: The Case of the River Itchen,
W89-00956 4B

GILL, J. Y.
Chemical Environment of Salvinia molesta Mitchell: Ionic Concentrations of Infested Waters,
W89-00106 5B

GILL, T. S.
Branchial and Renal Pathology in the Fish Exposed Chronically to Methoxy Ethyl Mercuric Chloride,
W89-01156 5C

GILLILAND, M. W.
Land Application of Domestic Wastewater, Wood Production, and Sludge Composting: An Economic and Energy Production Analysis,
W89-00465 5E

GINN, T. C.
Hepatic Lesions in English Sole (Parophrys vetulus) from Commencement Bay, Washington (USA),
W89-00859 5C

GIORANO, G.
Estimation of the Time Scale of the Geomorphologic Instantaneous Unit Hydrograph from Effective Streamflow Velocity,
W89-00704 2E

GIOVANOLI, F.
Interpretation of Metal Profiles in a Sediment Core from Lake Geneva: Metal Mobility or Pollution,
W89-00694 5B

Records of Riverborne Turbidity Currents and Indications of Slope Failures in the Rhone Delta of Lake Geneva,
W89-01049 2J

GIROUX, J.-F.
Factors Influencing Aboveground Production of Scirpus Marshes in the St. Lawrence Estuary, Quebec, Canada,
W89-00529 2L

GLADKOV, E. G.
Capacity of Ice-Covered Canals,
W89-01177 8B

GLASER, P. H.
Development of Streamlined Bog Islands in the Continental Interior of North America,
W89-00434 2H

GLAVAS, S.
Wet-Only Precipitation Study in a Mediterranean Site, Patras, Greece,
W89-01152 2B

GLICK, F. L.
Design Considerations for Package Water Treatment Systems,
W89-01117 5F

GLOOSCHENKO, W. A.
Use of Mires in Monitoring the Atmospheric Deposition of Heavy Metals,
W89-00123 5A

GLOYNA, E. F.
Look to the Future: Environmental Education,
W89-01121 5G

GOBEIL, C.
Dissolved Mercury Behaviour in the Saint Lawrence Estuary,
W89-00285 5B

GOBIN, A. R.
Upgrading Water Systems through Planning,
W89-00746 6B

GOENAGA, X.
Aluminum Speciation in Surface Waters from a Welsh Upland Area,
W89-01055 5B

GOL'TSMAN, V. K.
Certain Characteristics of Calculating Angular Retaining Walls,
W89-00076 8A

New Pumped-Storage Station Designs,
W89-00556 8C

GOLA, I.
Micronucleus Test: Examples of Application to Marine Ecology,
W89-01042 5A

GOLACHOWSKA, J.
Diurnal Fluctuations of Phosphorus Forms in Lake Water and Seston in Pluss-See,
W89-00246 2H

GOLDMAN, C. R.
Recurrence of Daphnia rosea in Lake Tahoe: Analysis of a Population Pulse,
W89-00216 2H

Seasonal Phytoplankton Demographic Processes and Experiments on Interspecific Competition,
W89-00906 2H

Summer Dynamics of the Deep Chlorophyll Maximum in Lake Tahoe,
W89-00224 2H

GOLDMAN, J. C.
Dynamics of Protistan Carbon and Nutrient Cycling,
W89-00383 2L

GOLLNITZ, W. D.
Source Protection and the Small Utility,
W89-01116 5G

GONZALEZ, E. B.
Determination of Polychlorinated Dibenzofurans in Surface Water by Means of Liquid Chromatography Using on-Line Sample Preconcentration and Different Spectroscopic Detection Techniques,
W89-00590 5A

GONZALEZ-FARIAS, F.
Effect of Mangrove Humic-Like Substances on Biodegradation Rate of Detritus,
W89-00476 2L

GOOD, R. E.
Stream Chemistry in the New Jersey Pinelands: The Influence of Precipitation and Watershed Disturbance,
W89-00716 5B

GOODCHILD, C. M.
Comparison of Nutrients in the Interstitial Water of Reducing (Tamar Estuary) and Oxic (Carmarthen Bay) Coastal Sediments,
W89-00156 2L

GOODE, D. J.
Groundwater Velocity Magnitude in Radionuclide Transport Calculations,
W89-00903 5B

GOODRICH, D. M.
Meteorologically Induced Flushing in Three U.S. East Coast Estuaries,
W89-00281 2L

GOOIJER, C.
Determination of Polychlorinated Dibenzofurans in Surface Water by Means of Liquid Chromatography Using on-Line Sample Preconcentration and Different Spectroscopic Detection Techniques,
W89-00590 5A

GORDON, D. C.
Adventures in Holistic Ecosystem Modelling: The Cumberland Basin Ecosystem Model,
W89-00675 2L

Nutrient Dynamics in Cumberland Basin - Chignecto Bay, A Turbid Macrotidal Estuary in the Bay of Fundy, Canada,
W89-00152 2L

GORODNYANSKII, V. I.
Adjusting and Modernization of the System Converting Units to Synchronous Capacitor Operation at the Sayano-Shushenskoe Hydroelectric Station,
W89-00074 8C

GORSKI, W.
Simple Self-Acting Hydrobiological Sampler (Prosty samoczynny czerpacz hydrobiologiczny),
W89-00033 7B

GOTLIB, E. M.
Effective Coatings for Hydraulic Structures,
W89-00075 8G

GOTZ, A.
Chromium Trace Determination in Inorganic, Organic and Aqueous Samples with Isotope Dilution Mass Spectrometry (Chromspurenbestimmungen in Anorganischen, Organischen und wa-Brigen Proben mit der Massenspektrometrischen Isotopenverdunnungsanalyse),
W89-00268 5A

GOULD, G.
Simulation of Regional Ground Water Flow in Bedrock, Southwestern New York-Northwestern Pennsylvania,
W89-00882 2F

GOUNARIDOU, X.
Correlation of Some Organic Pollution Factors in Water Systems in Northern Greece,
W89-00566 5B

GOUNARIS, V.
Gravimetric Measurement of Adsorption Parameters in Water Systems with a Quartz Spring Balance,
W89-01216 5A

GOW, T. A. K.
Epilithic Diatoms of the Clyde Estuary,
W89-00808 2L

GOWEN, R.
Phytoplankton Ecology of the Firth of Clyde Sea-Lochs Striven and Fyne,
W89-00813 2L

GOYLA, S. M.
Microbial Pollution of Well Water in Southeastern Minnesota,
W89-00887 5B

GRACHEV, N. R.
Regularities in the Formation of Curved Channels,
W89-00041 2J

GRADY, C. P. L.
Effect of Culture History on the Determination of Biodegradation Kinetics by Batch and Fed-Batch Techniques,
W89-00513 5D

GRAF, M. E.
Short-term Dynamics of a Melosira Population in the Plankton of an Impoundment in Central Chile,
W89-00214 2H

GRAHAM, N. J. D.
Package Water Treatment Facilities for Refugee Communities,
W89-00841 5F

GRAHAM, R. J.
Effects of Temperature and Streamflow on Time and Duration of Spawning by Smallmouth Bass,
W89-00373 2H

GRAHAM-TOMASI, T.
Ex Post Analysis of Flood Control: Benefit-Cost Analysis and the Value of Information,
W89-00983 6C

GRAINGER, E. H.
Community Structure of Zooplankton in Eastern Hudson Bay,
W89-01232 2L

GRANELI, W.
Influence of Microphytobenthos on the Nutrient Flux between Sediment and Water: A Laboratory Study,
W89-01036 2L

GRANEY, R. L.
Comparison of Three Sediment Bioassay Methods Using Detroit River Sediments,
W89-01097 5A

GRANTHAM, B.
Phytoplankton Ecology of the Firth of Clyde Sea-Lochs Striven and Fyne,
W89-00813 2L

GRASSO, D.
Ozone-Induced Particle Destabilization,
W89-01120 5F

GRATTON, Y.
Satellite Observations of Tidal Upwelling and Mixing in the St. Lawrence Estuary,
W89-00834 2L

GRAVELAND, A.
Central Softening by Crystallization in a Fluidized-Bed Process,
W89-00421 5F

GRAY, R. H.
Avoidance of a Water-Soluble Fraction of Coal Liquid by Fathead Minnows,
W89-00321 5C

GRAYMAN, W. M.
Contaminant Propagation in Distribution Systems,
W89-00494 5F

Modeling Contaminant Propagation in Drinking Water Distribution Systems,
W89-00929 5F

GREBENSHCHIKOV, Y. S.
Automation of Conveyor Transport at the Construction Site of Earth Dams,
W89-01173 8H

GRENELL, P.
Once and Future Experience of the California Coastal Conservancy,
W89-01067 6E

GRENNEY, W. J.
Fate and Transport of Organics in Soil: Model Predictions and Experimental Results,
W89-01239 5B

GRENZ, R.
Phosphorus Determination in Rivers (Phosphor in Fliessgewaessern und Seine Analytische Bestimmung),
W89-00735 5A

GRESZTA, J.
Influence of Dusts from Chosen Industrial Plants on Particular Links of Forest Ecosystem of the Niepolomice Forest,
W89-00081 5C

GRIGAL, D. F.
Decomposition in an Ombrotrophic Bog and a Minerotrophic Fen in Minnesota,
W89-00742 2H

GROBBELAAR, J. U.
Measurement of Primary Productivity in a High-Rate Oxidation Pond (HROP),
W89-00213 2H

GRONDIN, L. D.
Influence of an Arctic Large-Lakes System on Mesoclimate in South-Central Baffin Island, N.W.T., Canada,
W89-00437 2H

GROSH, D.
Contamination of Farmstead Wells by Pesticides, Volatile Organics, and Inorganic Chemicals in Kansas,
W89-00946 5B

GROSHOV, M. E.
Deformation of Dams with a Facing and Their Seismic Stability,
W89-00070 8D

GROSS, M.
Recreation Resource Allocation Model for Public Drinking Reservoirs,
W89-00921 6D

GROSSER, R.
Negative Thermal Ionization Mass Spectrometry of Selenium: Part 1. Isotope Ratio Measurements and Determinations in Aquatic Systems with the Isotope Dilution Technique (Negative Thermionen-Massenspektrometrie von Selen: Teil 1. Isotopenverhaeltnismessungen sowie Konzentrationsbestimmungen in Aquatischen Systemen mit der Isotopenverduennungsanalyse),
W89-00737 5A

GRUGET, P.
Optimization of the Production and Pumping Costs of the Nice Water Network (Optimisation de la Production et des Pompages sur le Reseau d'Eau de Nice),
W89-00922 5F

GSCHWEND, P. M.
Numerical Modeling of Sorption Kinetics of Organic Compounds to Soil and Sediment Particles,
W89-00981 5B

GU, R.
Analysis of Turbulent Buoyant Jet in Density-Stratified Water,
W89-00491 5B

Mixing of Temperature-Stratified Lakes and Reservoirs by Buoyant Jets,
W89-00492 5G

GUA, J.-Y.
Simultaneous Removal of Heavy Metal Ions from Wastewater by Foam Separation Techniques,
W89-00265 5D

GUANGFA, R.
Determination of Gross-Beta Radioactivity in Water of the Changjiang River and Sea Water Near Its Entrance to Sea, (in Chinese),
W89-00534 2H

GUDE, H.
Loss Processes Influencing Growth of Planktonic Bacterial Populations in Lake Constance,
W89-00217 2H

GUERTIN, D. P.
Regression Estimates for Topological-Hydrograph Input,
W89-00304 2E

GUERZONI, S.
Sediment-Water Core Sampler for Coastal Pollution Studies,
W89-00641 5A

GUIOT, S. G.
Anaerobic Treatment of Leachate Using Fixed Film and Sludge Bed Systems,
W89-01238 5D

GUIYING, T.
Extraction and Determination of Chlorophyll from Benthic Green Algae with Dimethyl Sulfoxide, (in Chinese),
W89-00539 7B

GUNKEL, G.
Investigations of the Ecotoxicological Effect of an Herbicide in an Aquatic Model Ecosystem: II. Food Chain Significance and Pesticide Balance (Untersuchungen zur okotoxikologischen Wirkung eines Herbizids in einem aquatischen Modellokosystem: II. Nahrungskettenprobleme und Schadstoffbilanzierung),
W89-00175 5C

GUNTHER, R.
Toxicity of an Anionic Detergent to the Spawn and Larvae of Anurans (Amphibia),
W89-00139 5C

GUPTA, G. S.
Removal of Chrome Dye from Carpet Effluents Using Coal: I,
W89-00630 5D

GUPTA, P. K.
Study of the Temperature Dependence of the Acute Toxicity of Pentachlorophenol to a Freshwater Pond Snail, Viviparus bengalensis L.,
W89-00078 5C

GUSSMAN, J. B.
California Tahoe Conservancy: Applying the Principles,
W89-01068 6E

GUTIERREZ-GALINDO, E. A.
Mercury in Freshwater Fish and Clams from the Cerro Prieto Geothermal Field of Baja California, Mexico,
W89-01153 5B

HAAS, C. N.
Effects of Discontinuing Disinfection on a Receiving Water,
W89-00515 5D

Micromixing and Dispersion in Chlorine Contact Chambers,
W89-00622 5D

HAASE, B. L.
Baseline Study of Jordan Creek, City of Allentown, Lehigh County, Pennsylvania,
W89-00313 5C

HABIB, A.
Intrapedal Macropore Distribution and Infiltration Rate of Three Friona Polypedons,
W89-00408 2G

HAEMMERLI, J.
Nonparametric Tests for Trend Detection in Water Quality Time Series,
W89-00867 7C

HAGER, W. H.
Mobile Flume for Circular Channel,
W89-00757 7B

HAGINO, T.
Formation of 1-Nitropyrene by Photolysis of Pyrene in Water Containing Nitrite Ion,
W89-00586 5B

HAGLUND, P.
Analysis of Halogenated Polycyclic Aromatic Hydrocarbons in Urban Air, Snow and Automobile Exhaust,
W89-00613 5B

HAHN, N. A.
Disposal of Radium Removed from Drinking Water,
W89-01106 5E

HAIG, A. J. N.
Use of the Clyde Estuary and Firth for the Disposal of Effluents,
W89-00824 5E

HAJJAR, L. M.
Septic System Performance on a Coastal Barrier Island,
W89-01163 5D

HAKANSON, L.
Distribution of Chlorinated Organic Substances from Pulp Mills,
W89-00359 5B

HALAS, S.
Chemistry and Delta 13C of Total Dissolved Carbon in Waters of Selected Springs Nearby Lublin City: Weekly Observations from October 1982 to June 1983,
W89-00895 2F

HALBERTSMA, J.
Modelling Soil Water Dynamics in the Unsaturated Zone: State of the Art,
W89-01014 2G

HALL, D. C.
Comparison of Instream and Laboratory Methods of Measuring Sediment Oxygen Demand,
W89-00869 7B

HALLACHER, L. E.
Distribution of Arsenic in the Sediments and Biota of Hilo Bay, Hawaii,
W89-00677 5B

HALLBACKEN, L.
Changes in Soil Acidity in Two Forest Areas with Different Acid Deposition: 1920s to 1980s,
W89-00444 5B

HALLER, W. T.
Effect of Gibberellic Acid and 2,4-D on Water Hyacinths,
W89-00105 4A

HAMANN, R.
Determination of Phenoxy Acid Herbicides in Water Samples,
W89-00576 5A

HAMBLIN, P. F.
Thermal Simulation of a Lake with Winter Ice Cover,
W89-01044 2H

HAMILTON, J. D.
Status of Fish Populations in the Clyde Estuary,
W89-00809 2L

HAMILTON, L.
Catalyst for Regionalization of Rural Water Systems,
W89-00883 6E

HAMILTON-TAYLOR, J.
Dynamics of Iron and Manganese in the Surface Sediments of a Seasonally Anoxic Lake,
W89-00188 2H

HAMMAN, K. C. D.
Changes in the Fish Fauna of the Bot River Estuary in Relation to Opening and Closure of the Estuary Mouth,
W89-00665 2L

HAMODA, M. F.
Anaerobic Treatment of Leachate Using Fixed Film and Sludge Bed Systems,
W89-01238 5D

HANAKI, K.
River Basin Water Quality Management in Stochastic Environment,
W89-00490 5G

HANGANG, L.
Primary Studies on Population Dynamics of 3 Species of Cladocera (Waterflea) in Dianshan Lake, (in Chinese),
W89-00198 2H

HANNAH, S. A.
Removal of Organic Toxic Pollutants by Trickling Filter and Activated Sludge,
W89-01133 5D

HANSEN, S. P.
Filtration Technologies for Water Treatment,
W89-01099 5F

HANZON, B. D.
Design Considerations for Package Water Treatment Systems,
W89-01117 5F

HAO, Z.
Determination of Cobalt Ions in Natural Waters Using Differential Pulse Adsorptive Stripping Voltammetry,
W89-00480 5A

HARDIG, J.
Physiological Disturbances in Fish Exposed to Bleached Kraft Mill Effluents,
W89-00363 5C

HARDISTY, J.
Measurement of Shallow Water Wave Direction for Longshore Sediment Transport,
W89-01082 2J

HARDY, B. L. S.
Biology of Harpacticoid Copepods in the Meiofauna of Shallow Subtidal Sands,
W89-00818 2L

HARDY, J.
Sea-Surface Microlayer of Puget Sound: Part I: Toxic Effects on Fish Eggs and Larvae,
W89-00853 5C

HARDY, J. T.
Contaminant Concentrations and Toxicity of Sea-Surface Microlayer Near Los Angeles, California,
W89-00857 5C

Laboratory Study of the Accumulation and Toxicity of Contaminants at the Sea Surface from Sediments Proposed for Dredging,
W89-00858 5E

Sea-Surface Microlayer of Puget Sound: Part II: Concentrations of Contaminants and Relation to Toxicity,
W89-00854 5C

HARKIN, J. M.
Transport Modelling of Biological Tracers from Septic Systems,
W89-01226 5B

HARPER, J. K.
Implications of Public Ownership of Irrigation Canal Systems in the Texas Rice Belt: Impacts on Water Use and Water Price,
W89-00460 6E

HARRIS, G. P.
Interannual Variability in Climate and Fisheries in Tasmania,
W89-00847 2A

HART, H. V.
Determination of Naphthenic Acids in California Crudes and Refinery Wastewaters by Fluoride Ion Chemical Ionization Mass Spectrometry,
W89-00209 5A

HARTLEY, J. P.
Comparison of the Fauna Retained On 0.5 mm and 1.0 mm Meshes from Benthic Samples Taken in the Beatrice Oilfield, Moray Firth, Scotland,
W89-00783 2L

Macrobenthos of the Beatrice Oilfield, Moray Firth, Scotland,
W89-00782 2L

HARTUNG, H.
Package Water Treatment Facilities for Refugee Communities,
W89-00841 5F

HARVEY, B. C.
Susceptibility of Young-of-the-Year Fishes to Downstream Displacement by Flooding,
W89-00295 2H

HARVEY, N.
Coastal Management Issues for the Mouth of the River Murray, South Australia,
W89-01072 6E

HASANEN, E.
Determination of Total Organic Chlorine and Bromine in Water Samples by Adsorption onto Activated Carbon and Neutron Activation Analysis,
W89-00588 5A

HASLAM, S. M.
Sources of Watercourse Pollution in Italy and Mediterranean France, Assessed by Macrophytes,
W89-00563 5B

HASSAN, H. N. A.
Determination of Traces of Bismuth in Water with Polyurethane Foam Thin-Layer Spectrophotometry,
W89-00482 5A

HAUSER, J.
Apparatus for Assessing Sulfide Generation Rates from Sewer Slimes,
W89-00497 5D

HAVENS, K. E.
Effects of Acidification and Phosphorus Addition on Phytoplankton Biomass and Productivity in a Circum-Neutral Mesotrophic Lake Receiving Acid Precipitation,
W89-00179 2H

HAVERKAMP, R.
Infiltration under Ponded Conditions: 2. Infiltration Equations Tested for Parameter Time-Dependence and Predictive Use,
W89-00740 2G

HAYANO, I.
Experiments on Seawater Desalination by Membrane Distillation,
W89-01063 3A

HAYASHI, N.
Precipitation and Indirect Spectrophotometric Determination of Sulfate Traces in Fresh Water with Lead Nitrate and Tetraphenylporphine Trisulfonic Acid,
W89-01085 5A

HAYES, S.
Influence of Feeding Procedure on Microbial Reductions and Performance of Anaerobic Digestion,
W89-00511 5D

HAYWARD, R. S.
Eutrophication Effects of Prey Size and Food Available to Yellow Perch in Lake Erie,
W89-00030 5C

HECKMAN, C. W.
Role of Marsh Plants in the Transport of Nutrients as Shown by a Quantitative Model for the Freshwater Section of the Elbe Estuary,
W89-00120 2L

HEGEDUS, M.
Water Quality of the Tisza River and the Alpar Backwater,
W89-00143 5B

HEGEWALD, M.
Setting the Water Quality Agenda: 1988 and Beyond,
W89-00505 5G

HEIBERG, A.
Evaluation of the 'Fugacity' (FEQUM) and the 'EXAMS' Chemical Fate and Transport Models: A Case Study on the Pollution of the Norrsundet Bay (Sweden),
W89-00357 5B

HEIDMAN, J. A.
Activated Sludge Systems with Biomass Particle Support Structures,
W89-01256 5D

HEIDTKE, T. M.
Factors Affecting the Efficiency of Some Estimates of Fluvial Total Phosphorus Load,
W89-01249 5B

HEIMAN, A.
Contamination of Farmstead Wells by Pesticides, Volatile Organics, and Inorganic Chemicals in Kansas,
W89-00946 5B

HEINDEL, B.
Phytoplankton Studies of Slowly Running Waters: Rivers Danube and Vils (Phytoplanktonstudien an langamfliessenden Gewassern: Donau und Vils),
W89-00172 2E

HELDER, W.
Dynamics of Dissolved Silicium and Nitrogen-Nutrients at Low Temperature in the EMS-Dollard Estuary,
W89-00673 2L

HELLAWELL, J. M.
River Regulation and Nature Conservation,
W89-00961 4A

HELLMANN, H.
Head-Space Analysis of Readily Volatile Chlorinated Hydrocarbons in Air and Water (Head-Space-Analytik Leichtfluechtiger Chlorkohlenwasserstoffe in Luft und Wasser),
W89-00504 5A

HEMING, T. A.
Acute Toxicity of Thiocyanate to Trout,
W89-00330 5C

HENDERSON, A. R.
Status of Fish Populations in the Clyde Estuary,
W89-00809 2L

HENDERSON, P. L.
Guinea Worm Disease in Northern Uganda: A Major Public Health Problem Controllable Through an Effective Water Programme,
W89-00278 5F

HENLEY, M. V.
Hydrocarbon Fuel Spill Dispersion on Water: A Literature Review,
W89-00598 5B

HENRY, M. G.
Leaching of Retorted Oil Shale: Assessing the Toxicity to Colorado Squawfish, Fathead Minnows, and Two Food-Chain Organisms,
W89-00329 5C

HENRY, R.
Nutrient Release Through Decomposition of Diplodon Delodontus Expansus (Mollusca, Bivalvia) and Some Considerations of its Effects on the Ecology of a Small Tropical Reservoir,
W89-00009 2H

HERBERT, R. A.
Development of Mass Blooms of Photosynthetic Bacteria on Sheltered Beaches in Scapa Flow, Orkney Islands,
W89-00795 2L

HERITAGE, I. D.
Instrumentation for 7-Day Continuous Cycle Monitoring of Metals with Automated On-Line Sample Preparation, High-Performance Liquid Chromatography, and Electrochemical Detection,
W89-00210 5A

HERMAN, J. S.
Chemical Evolution of a Travertine-Depositing Stream: Geochemical Processes and Mass Transfer Reactions,
W89-01250 2K

HERNANDEZ, L. H.
Determination of Thiram in Water and Soils by Cathodic Stripping Voltammetry Based on Adsorptive Accumulation,
W89-01087 5A

HERNROTH, L.
Large-Scale and Long-Term Variations in the Zooplankton Community of the Gullmar Fjord, Sweden, in Relation to Advective Processes,
W89-01038 2L

HERSHELMAN, G. P.
Contaminant Concentrations and Toxicity of Sea-Surface Microlayer Near Los Angeles, California,
W89-00857 5C

HERSHFELD, D. C.
Fish Production in the Kanawha River and its Relation To Barge Traffic,
W89-00249 6G

HESS, J. W.
Storm Response of the Karstic Carbonate Aquifer of Southcentral Kentucky,
W89-00349 2A

HETTIARATCHI, J. P. A.
Procedure for Evaluating Municipal Solid Waste Leachate Components Capable of Causing Volume Shrinkage in Compacted Clay Soils,
W89-00621 5E

HEUILLET, E.
Use of Factorial Experimental Design to Evaluate How Biotic and Abiotic Factors Influence Cadmium Accumulation in the Unicellular Alga Dunaliella bioculata,
W89-01043 5B

HEUMANN, K. G.
Chromium Trace Determination in Inorganic, Organic and Aqueous Samples with Isotope Dilution Mass Spectrometry (Chromspurenbestimmungen in Anorganischen, Organischen und wa-Brigen Proben mit der Massenspektrometrischen Isotopenverdunnungsanalyse),
W89-00268 5A

Determination of Heavy Metals at the Pg/g Level in Antarctic Snow with DPASV and IDMS,
W89-00270 5A

Determination of Nitrate at the Ng/g Level in Antarctic Snow Samples with Ion Chromatography and Isotope Dilution Mass Spectrometry,
W89-00269 5A

Isotope Ratio Measurements of Mo, V, Ti, and Zr and the Determination of These Elements in Water Samples with a Thermal Ionization Quadrupole Mass Spectrometer (Isotopenverhaltnismessung von Mo, V, Ti and Zr Sowie Deren Konzentrationsbestimmung in Wassern Mit Einem Thermionen-Quadrupol-Massenspektrometer),
W89-00267 5A

Negative Thermal Ionization Mass Spectrometry of Selenium: Part 1. Isotope Ratio Measurements and Determinations in Aquatic Systems with the Isotope Dilution Technique (Negative Thermionen-Massenspektrometrie von Selen: Teil 1. Isotopenverhaeltnismessungen sowie Konzentrationsbestimmungen in Aquatischen Systemen mit der Isotopenverduennungsanalyse),
W89-00737 5A

Nitrate Trace Determinations in Snow and Firn Core Samples of Ice Shelves at the Weddell Sea, Antarctica,
W89-01258 5B

HEYERDAHL, E.
Aliphatic and Polycyclic Aromatic Hydrocarbons in Urban Rain, Snow and Fog,
W89-00309 5B

HEYL, C. W.
Variations in the Use of the Bot River Estuary by Water-Birds,
W89-00661 2L

HEYMSFIELD, G. M.
Comparison of High-Altitude Remote Aircraft Measurements with the Radar Structure of an Oklahoma Thunderstorm: Implications for Precipitation Estimation from Space,
W89-00844 7B

HICKEY, C. W.
Benthic Chamber for Use in Rivers: Testing against Oxygen Mass Balances,
W89-00488 7B

HIGGINS, D. A.
Bacterial Water Quality Responses to Four Grazing Strategies: Comparisons with Oregon Standards,
W89-01170 5B

HIGGS, G.
Hydrological Changes and the River Regulation in the UK,
W89-00957 4A

HIGUCHI, K.
Relationship Between delta-D and delta-18-O Values of Falling Snow Particles from a Separate Cloud,
W89-00406 2C

HILL, B.
Water/Wastewater Facilities Get Better with Electronics,
W89-00392 5D

HILL, B. H.
Typha Productivity in a Texas Pond: Implications for Energy and Nutrient Dynamics in Freshwater Wetlands,
W89-00524 2H

HILL, T. A.
Field Study of the Cloud Chemistry and Cloud Microphysics at Great Dun Fell,
W89-00308 5B

HILL, W. R.
Nutrient and Light Limitation of Algae in Two Northern California Streams,
W89-00296 2H

HILLEBRAND, M. J. T.
Partitioning of Organochlorines Between Water, Particulate Matter and Some Organisms in Estuarine and Marine Systems of the Netherlands,
W89-00672 5B

HILLEBRAND, M. T. J.
River Ems: Processes Affecting the Behaviour of Metals and Organochlorines during Estuarine Mixing,
W89-00149 5B

HILLEL, D.
Groundwater Recharge in Arid Regions: Review and Critique of Estimation Methods,
W89-00914 2F

HINES, M. E.
Trace Metal Geochemistry of Pore Water Brines from Two Hypersaline Lakes,
W89-01079 2K

HINO, K.
Vertical Distribution of Phytoplankton in a Stratified Lake (Lago Dom Helvecio, Southeastern Brazil) with Special Reference to the Metalimnion,
W89-00768 2H

HIPEL, K. W.
Data Analysis of Water Quality Time Series in Lake Erie,
W89-00866 7C

Nonparametric Approaches to Environmental Impact Assessment,
W89-00861 7C

HIRAI, M.
Experiments on Seawater Desalination by Membrane Distillation,
W89-01063 3A

HIRSCH, R. M.
Short-Term Trends in Sulfate Deposition at Selected Bulk Precipitation Stations in New York,
W89-00432 5B

Statistical Methods and Sampling Design for Estimating Step Trends in Surface-Water Quality,
W89-00862 7A

HITCHIN, G. G.
Richness of Aquatic Macrophyte Floras of Soft Water Lakes of Differing pH and Trace Metal Content in Ontario, Canada,
W89-00103 5C

HITES, R. A.
Accumulation of Polycyclic Aromatic Hydrocarbons in Acid Sensitive Lakes,
W89-01074 5B

Atmospheric Deposition of Polycyclic Aromatic Hydrocarbons to Water Surfaces: A Mass Balance Approach,
W89-01257 5B

HJELMFELT, M.
Mesoscale Spiral Vortex Embedded within a Lake Michigan Snow Squall Band: High Resolution Satellite Observations and Numerical Model Simulations,
W89-00748 2B

HO, C.-N.
Determination of Free Cyanide in Water by Released Fluorescence of a Dissociated Ternary Complex,
W89-00477 5A

HO, K. C.
Routine Determination of Polychlorinated Biphenyl Residues in Fish and Shellfish in Taipei County,
W89-00605 5A

HOBBS, B. F.
Analytical Simulation of Water System Capacity Reliability: 1. Modified Frequency-Duration Analysis,
W89-01240 5F

Analytical Simulation of Water System Capacity Reliability: 2. A Markov Chain Approach and Verification of the Models,
W89-01241 5F

HOBSON, L. A.
Seasonal Variations and Spatial Gradients of Nitrogenous Nutrients in Waters of Southeastern Vancouver Island, British Columbia, Canada.
W89-00158 2L

HOCENSKI, V.
Investigation of the Production of Lipophilic Volatile Organohalogen Materials during Laboratory Chlorination of some Ground Water Samples from Yugoslavia,
W89-00608 5F

HOCHGESCHWENDER, K.
Studies of the Oxidative Photoinduced Degradation of Silicones in the Aquatic Environment,
W89-00617 5B

HODGSON, M. P.
Finite Element Computation of Shape Factors for Kirkham's Piezometer Tube Method for Hydraulic Conductivity of Saturated Soil,
W89-00911 2G

HODSON, P. V.
Estimating the Acute Toxicity of Waterborne Chemicals in Trout from Measurements of Median Lethal Dose and the Octanol-Water Partition Coefficient,
W89-01095 5C

HODSON, R. E.
Adaptation of Phytoplankton-Degrading Microbial Communities to Thermal Reactor Effluent in a New Cooling Reservoir,
W89-00336 5C

HOFFMAN, R. E.
Land Application of Domestic Wastewater, Wood Production, and Sludge Composting: An Economic and Energy Production Analysis,
W89-00465 5E

HOGARTH, W. L.
Air and Water Flow: I. Horizontal Flow with an Arbitrary Flux Boundary Condition,
W89-00347 2G

Air and Water Flow: II. Gravitational Flow with an Arbitrary Flux Boundary Condition,
W89-00348 2G

Extension of the Fujita Solution to Air and Water Movement in Soils,
W89-00725 2G

HOGELAND, A. M.
Biomass, Productivity and Life History Traits of Juncus militaris Bigel. in Two Rhode Island (U.S.A.) Freshwater Wetlands,
W89-00100 2H

HOKENSON, R. A.
Lightning Spurs Hydro Rehab,
W89-01255 8C

HOLDER, G. A.
Apparatus for Assessing Sulfide Generation Rates from Sewer Slimes,
W89-00497 5D

HOLLAND, M.
Eutrophication of Lakes and Reservoirs: A Framework for Making Management Decisions,
W89-00439 5C

HOLLIS, G. E.
Quantity of Stormwater Runoff from Ten Stretches of Road, a Car Park and Eight Roofs in Hertfordshire, England During 1983,
W89-00912 4C

HOLLOWAY, L.
Use of Mires in Monitoring the Atmospheric Deposition of Heavy Metals,
W89-00123 5A

HOLLYDAY, E. F.
Dry Stream Reaches in Carbonate Terranes: Surface Indicators of Ground-Water Reservoirs,
W89-00870 7B

HOLM, H. W.
Estimate of the Variability in Biotransformation Kinetics of Xenobiotics in Natural Waters by Aufwuchs Communities,
W89-00559 5B

HOLM, T. R.
Oxygen Transfer Through Flexible Tubing and Its Effects on Ground Water Sampling Results,
W89-00943 5A

HOMER, R. R.
Lake Response Modeling Using Biologically Available Phosphorus,
W89-01236 5C

HONGDAO, W.
Analysis and Assessment of Water Quantities in Lakes of China, (In Chinese),
W89-00531 2H

HONJO, T.
Precipitation and Indirect Spectrophotometric Determination of Sulfate Traces in Fresh Water with Lead Nitrate and Tetraphenylporphine Trisulfonic Acid,
W89-01085 5A

HOOPER, R. P.
Assessing the Birkenes Model of Stream Acidification Using a Multisignal Calibration Methodology,
W89-00974 7B

Multisignal Automatic Calibration Methodology for Hydrochemical Models: A Case Study of the Birkenes Model,
W89-00973 5B

HOOVER, J. R.
Chemical-Hydrologic Interactions in the Near-Stream Zone,
W89-00717 2E

HOPGOOD, H. A.
Studies on Epilithic and Epiphytic Diatoms in a Chalkstream: Comparative Estimates of Chlorophyll a and Its Derivatives,
W89-01186 2H

HOPKINS, J. P.
Valves for Controlling Pressure, Flow and Level,
W89-01102 5F

HOPKINS, P. J.
Exploited Fish and Shellfish Species in the Moray Firth,
W89-00779 2L

HOPNER, T.
Examination of the Connection Between the Patchiness of Benthic Nutrient Efflux and Epiphytobenthos Patchiness on Intertidal Flats,
W89-00161 2L

HOPPING, W. D.
Nitrilotriacetic Acid (NTA) Environmental Monitoring Program in Indiana: 1979 to 1983,
W89-01089 5A

HORAN, N. J.
Fecal Coliform Fingertip Count: A Potential Method for Evaluating the Effectiveness of Low Cost Water Supply and Sanitation Initiatives,
W89-00379 5G

Isolation, Identification and Characterisation of Filamentous and Floc-Forming Bacteria from Activated Sludge Flocs,
W89-00648 5D

HORN, D. R.
Annual Flow Statistics for Ungaged Streams in Idaho,
W89-00753 7C

HORNBERGER, G. M.
Interactions Between Groundwater Seepage and Sediment Porewater Sulphate Concentration Profiles in Lake Anna, Virginia,
W89-00910 5B

HORNUNG, M.
Stream Acidification Trends in the Welsh Uplands: A Modelling Study of the Llyn Brianne Catchments,
W89-01206 5C

HOSE, J. E.
Contaminant Concentrations and Toxicity of Sea-Surface Microlayer Near Los Angeles, California,
W89-00857 5C

HOU, K.
Microporous Filters with Oxidizing Power for Iron and Manganese Removal from Water,
W89-00889 5F

HOUCK, M. H.
Planning Indiana's Water Infrastructure from a Competitive Perspective,
W89-00880 6B

HOUSTON, M.
Role of Sewage Effluent in the Accumulation of Macroalgal Mats on Intertidal Mudflats in Two Basins in Southern England,
W89-00159 5C

HOWLAND, R. J. M.
Nitrite and Ammonia in the Tamar Estuary,
W89-00154 5B

HRUDEY, S. E.
Procedure for Evaluating Municipal Solid Waste Leachate Components Capable of Causing Volume Shrinkage in Compacted Clay Soils,
W89-00621 5E

HSUEN-CHUN, Y.
Composite Method for Estimating Annual Actual Evapotranspiration,
W89-01141 2D

HUANG, J.-Y.
Simultaneous Removal of Heavy Metal Ions from Wastewater by Foam Separation Techniques,
W89-00265 5D

HUANG, M.-K.
Simultaneous Removal of Heavy Metal Ions from Wastewater by Foam Separation Techniques,
W89-00265 5D

HUANG, S.-D.
Simultaneous Removal of Heavy Metal Ions from Wastewater by Foam Separation Techniques,
W89-00265 5D

HUANG, W.
Concentrations of Trace Metals in the Qiantagnjiang River and its Estuary in Southern China,
W89-00443 5B

HUARUI, H.
Chromium Speciation in the Huanghe River and Its Estuarine Region, (in Chinese),
W89-00544 5B

HUBEL, H.
SEM-Analysis of Colonies of the Cyanophyte Nodularia Water Bloom from Baltic Sea,
W89-00193 2H

HUCK, P. M.
Review of the Use of XAD Resins to Concentrate Organic Compounds in Water,
W89-01215 5A

HUE, N. V.
Possible Mechanism for Manganese Phytotoxicity in Hawaii Soils Amended with a Low-Manganese Sewage Sludge,
W89-01169 5E

Sewage Sludge-Soil Interactions as Measured by Plant and Soil Chemical Composition,
W89-01161 5E

HUEBERT, B. J.
Liquid Cloudwater Collection Using Modified Mohnen Slotted Rods,
W89-00764 7B

HUGHES, D. A.
Spatial Variability of Short-Term Rainfall Amounts in a Coastal Mountain Region of Southern Africa,
W89-00932 2B

HUGHES, J. P.
Tau-Like Test for Trend in the Presence of Multiple Censoring Points,
W89-00865 7C

HUGHES, R. M.
Longitudinal Changes in Fish Assemblages and Water Quality in the Willamette River, Oregon,
W89-00029 2H

Toxic and Environmental Torts within Admiralty,
W89-00518 6E

HULL, A. B.
Background Aspects of Lake Restoration: Water Balance, Heavy Metal Content, Phosphorus Homeostasis,
W89-00014 2H

HULTGREN, A. B. C.
Demographic Study of Aerial Shoots of Carex rostrata in Relation to Water Level,
W89-00530 2H

HUMMEL, H.
Effects on the Benthic Fauna of Embanking an Intertidal Flat Area (The Markiezaat, Eastern Scheldt Estuary, The Netherlands),
W89-00676 6G

HUNG, Y.-T.
Performance of Vinyl Core Media Trickling Filter Plant for Secondary Treatment of Municipal Wastewater,
W89-00502 5D

HUNN, J. B.
Sensitivity of Young Striped Bass to Organic and Inorganic Contaminants in Fresh and Saline Waters,
W89-00320 5C

HUNT, D. N.
Derivation of Baseflow Recession Constant Using Computer and Numerical Analysis,
W89-01142 2E

HUNT, J. R.
Nonaqueous Phase Liquid Transport and Cleanup: I. Analysis of Mechanisms,
W89-00968 5B

Nonaqueous Phase Liquid Transport and Cleanup: II. Experimental Studies,
W89-00969 5B

HUNTER, J.
Sub-Littoral Fauna of the Inverness, Cromarty and Dornoch Firths,
W89-00784 2L

Water Quality in the Inverness and Beauly Firths,
W89-00789 5B

HUNTER, M.
Review of the Behaviour and Utilization of Polycarboxylic Acids as Detergent Builders,
W89-00620 5D

HURLBURT, S.
Problem with Nitrates,
W89-00965 5B

HURLEY, J. M.
Developer Financing of Public Wastewater Service Infrastructure,
W89-00507 5D

HURLIMANN, J.
Periphyton Diatom Communities and Trophic States of Three Shallow Lakes in the Pfynwald Region of Canton Valais, Switzerland,
W89-00195 2H

HURST, C. J.
Detection of Environmental Viruses in Sludge: Enhancement of Enterovirus Plaque Assay Titers with 5-Iodo-2'-Deoxyuridine and Comparison to Adenovirus and Coliphage Titers,
W89-01220 5A

HUSAIN, T.
Flow Simulation Using Channel Network Model,
W89-00751 7B

HUSTERT, K.
Formation of Oxygen Species and Their Reactions with Organic Chemicals in Aqueous Solution,
W89-00575 5B

HVITVED-JACOBSEN, T.
Effect of Sulfate and Organic Matter on The Hydrogen Sulfide Formation in Biofilms of Filled Sanitary Sewers,
W89-00510 5D

IBBITT, R. P.
Maximum Likelihood Criterion for Use With Data Collected at Unequal Time Intervals,
W89-00723 2E

IETSWAART, T.
Availability of Phosphorus Sources for Blooms of Phaeocystis pouchetii (Haptophyceae) in the North Sea: Impact of the River Rhine,
W89-00004 2L

IHRINGER, J.
Operational Models for Flood Calculations,
W89-01030 2A

IKAWA, M.
Evolution and Fine Structure of a Long-Lived Meso-alpha-Scale Convective System in a Baiu Frontal Zone. Part II: Meso-gamma-Scale Characteristics of Precipitation,
W89-00416 2B

ILYUSHIN, V. F.
Improvement of the Layouts and Design of Underground Hydraulic Structures,
W89-01172 8E

IMBODEN, D. M.
Origin and Size of Hypolimnic Mixing in Urnersee, the Southern Basin of Vierwaldstattersee (Lake Lucerne),
W89-00023 2H

INGRAHAM, N. L.
Fog Drip as a Source of Groundwater Recharge in Northern Kenya,
W89-00984 2F

IONESCU, N.
Viral Pollution of Surface Waters by Domestic Waste Water Discharge (Die Viral-Verunreinigung der Oberflachengewasser durch Ableiten der Haushaltsabwasser),
W89-00170 5B

IRWIN, K. C.
Sorption of Cationic Oligomers on Sediments,
W89-01094 5B

ISAKHANYAN, N. A.
Estimation of the Reliability of Earth Dams with Consideration of Seismic Loads,
W89-00557 8E

ISHIDA, N.
Utilization of Nitrogenous Nutrients by Natural Phytoplankton in Enriched Lake Waters,
W89-00773 2H

ISHIDA, Y.
Nitrogen Metabolism in the Brackish Lake Nakanoumi. III. Nitrification-Dentrification in Low Concentration of Dissolved Oxygen, (in Japanese),
W89-00769 2H

ISHIZAKI, K.
Mechanism of Inactivation of Tobacco Mosaic Virus with Ozone,
W89-01229 5F

ISLAM, S.
Multidimensional Modeling of Cumulative Rainfall: Parameter Estimation and Model Adequacy through a Continuum of Scales,
W89-00706 2B

ISTOK, J. D.
Geostatistics Applied to Groundwater Pollution: III. Global Estimates,
W89-00493 5B

ITO, A.
Photochemical Reaction of Biphenyl in Water Containing Nitrite or Nitrate Ion,
W89-00593 5B

ITTEKKOT, V.
Ca(+2)-Stress, Biological Response and Particle Aggregation in the Aquatic Habitat,
W89-00669 2K

IVANOV, F. M.
Works of S. V. Shestoperov on Frost Resistance of Hydrotechnical Concrete,
W89-00061 8F

IVANOVA, M.
Relationship between Zooplankton Development and Environmental Conditions in Different Types of Lakes in the Zone of Temperate Climate.
W89-00138 2H

IVASHCHENKO, I. N.
Evaluation of the Reliability of Wave-Protection Slab Revetments of Embankment Slopes,
W89-01176 8D

IYENGAR, L.
Removal of Cadmium using Chitosan,
W89-00496 5D

JACHEET, B.
Optimization of the Production and Pumping Costs of the Nice Water Network (Optimisation de la Production et des Pompages sur le Reseau d'Eau de Nice),
W89-00922 5F

JACKLING, S. J.
Organochlorine and Mercury Residues in Wild Mink and Otter: Comparison with Fish,
W89-01093 5B

JACOBS, B. L.
Evaluation of a Homogeneous Point Process Description of Arizona Thunderstorm Rainfall,
W89-00724 2B

JACOBS, J. D.
Influence of an Arctic Large-Lakes System on Mesoclimate in South-Central Baffin Island, N.W.T., Canada,
W89-00437 2H

JAEGER, D.
Ecological and Saprobiological Status of the Rhine (Der Oekologisch-Saprobiologische Zustand des Rheins),
W89-00498 2H

JAFFE, P. R.
Sorption and Desorption Dynamics of Aroclor 1242 to Natural Sediment,
W89-00991 5B

Tropical Eutrophic Lake Modeling and Parameter Discrimination,
W89-00872 2H

JAFFREZO, J. L.
Rain-Aerosol Coupling in Urban Area: Scavenging Ratio Measurement and Identification of Some Transfer Processes,
W89-00430 2B

JAGER, P.
Experiences With the Assessment of the Residual Water Flow in Regulated Water Courses in the Salzburg Region (Erfahrungen bei der Beurteilung der Restwasserfuhrung von Ausleitungsstrecken im Land Salzburg),
W89-00164 4A

JAHN, S. A. A.
Using Moringa Seeds as Coagulants in Developing Countries,
W89-00420 5F

JAHNKE, R. A.
Simple, Reliable, and Inexpensive Pore-Water Sampler,
W89-01051 7B

JAMES, P. K.
Identification of Rainfall Type From Weather Radar Data,
W89-00842 2B

JAMES, W. P.
Urban Runoff Simulation Model,
W89-00301 2E

JANAUER, G. E.
Characterization of the Interaction Between Viruses and a Solid Polymeric Contact Disinfectant,
W89-00884 5F

JANKOVIC, D.
Some Hydrochemical, Hydrobiological, and Ichthyological Features of Yugoslav Part of the Danube Lasting for Several Years (Einige hydrochemische, hydrobiologische und ichthyologische Eigenschaften der jugoslawischen Donaustrecke in mehrjahrigem Zeitraum),
W89-00165 5C

JANN, B.
Drift of Zooplankton in a Lake-Outlet (Glatt) in a Day-Night-Rhythm Depending from the Water Level,
W89-00025 2H

JANSSEN, D.
Gas Chromatographic-Mass Spectrometric Investigations on Lipophilic Anthropogenic Substances in Environmental Samples. II: A Splitter for the Simultaneous Detection of Capillary Gas Chromatograms by up to Four Different GC-Detectors,
W89-01086 5A

Toxicity of Sea-Surface Microlayer: Effects On Herring and Turbot Embryos,
W89-00855 5C

JANSSON, B.
Analysis of Halogenated Polycyclic Aromatic Hydrocarbons in Urban Air, Snow and Automobile Exhaust,
W89-00613 5B

JARDINE, W. G.
Geological and Geomorphological Setting of the Estuary and Firth of Clyde,
W89-00799 2L

JARRETT, R. D.
Experimental Marvin Windshield Effects on Precipitation Records in Leadville, Colorado,
W89-00876 7B

JARVINEN, A. W.
Acute and Chronic Toxicity of Triphenyltin Hydroxide to Fathead Minnows (Pimephales promeias) Following Brief or Continuous Exposure,
W89-01057 5C

JARVIS, A. C.
Zooplankton Community Grazing in a Hypertrophic Lake (Hartbeespoort Dam, South Africa),
W89-00220 2H

JAUREGUI, C. F.
Water Resources, Salinity and Salt Yields of the Rivers of the Bolivian Amazon,
W89-01213 2E

JEANNE, N.
Use of Factorial Experimental Design to Evaluate How Biotic and Abiotic Factors Influence Cadmium Accumulation in the Unicellular Alga Dunaliella bioculata,
W89-01043 5B

JEFFREY, W. H.
Mechanisms of DNA Utilization by Estuarine Microbial Populations,
W89-00340 2L

JEFTIC, L.
Coordinated Programme for Research and Monitoring of Pollution in the Mediterranean,
W89-00582 5A

JELINEK, R. T.
Operating a Small Full-Scale Ion Exchange System for Uranium Removal,
W89-01107 5F

JENIK, J.
Patterns of Temperature and Humidity in Wetland Biotopes,
W89-00124 2H

JENKINS, T. F.
Evaluation of Disposable Membrane Filter Units for Sorptive Losses and Sample Contamination,
W89-00623 5A

JENSEN, K. H.
Estimation of Catchment Rainfall Uncertainty and its Influence on Runoff Prediction,
W89-00892 2A

JEROME, J. H.
Particulate Concentrations in Lake St. Clair as Recorded by a Shipborne Multispectral Optical Monitoring System,
W89-00066 7B

JHA, I. N.
Removal of Cadmium using Chitosan,
W89-00496 5D

JHA, M.
Heavy-Metal Toxicity in the Cyanobacterium Nostoc linckia,
W89-00094 5C

JIANG, J.
Trace Element Content in Drinking Water of Nasopharyngeal Carcinoma Patients,
W89-00048 5C

JIANG, O.
Aerobic Biodegradation of Natural and Xenobiotic Organic Compounds By Subsurface Microbial Communities,
W89-01090 5B

JIANLU, Z.
Chemical Behavior of Metal Elements in the Sediments in the Hanjiang River Estuary and Shantou Port, (in Chinese),
W89-00202 2L

JIHUA, H.
Application of the Principle of Least Sigma to the Chemical Model of Natural Water, (in Chinese),
W89-00537 2H

JIMENEZ, B.
Selected Dyes for Residence Time Distribution Evaluation in Bioreactors,
W89-00404 5D

JING, D.
Application of Probability Weighted Moments in Estimating the Parameters of the Pearson Type Three Distribution,
W89-01198 7C

Determination of Probability Weighted Moments with the Incorporation of Extraordinary Values into Sample Data and Their Application to Estimating Parameters for the Pearson Type Three Distribution,
W89-01199 7C

JINGYI, T.
Dongjiang: A 500 MW Hydro Plant for Hunan Province,
W89-01001 8C

JOE, P.
Winter Cloud Water and Air Composition in Central Ontario,
W89-01265 5C

JOFRE, J.
Relationship between Numbers of Enteroviruses and Bacteriophages Infecting Bacteroides fragilis in Different Environmental Samples,
W89-00645 5A

JOHANSEN, S. W.
Lake Enrichment by Submersed Macrophytes: A Norwegian Whole-Lake Experience with Elodea canadensis,
W89-00131 2H

JOHNSEN, S.
Investigations of Chlorinated Thiophenes: A Group of Bioaccumulable Compounds Identified in the Effluents from Kraft Bleaching,
W89-00360 5B

JOHNSON, D. W.
Effects of Leaching and Whole-Tree Harvesting on Cation Budgets of Several Forests,
W89-01166 4C

JOHNSON, F. G.
Hydropower Development on Rivers in Scotland,
W89-00952 8C

JOHNSON, L. R.
Modified ATI Technique for Nowcasting Convective Rain Volumes over Areas,
W89-00090 2B

JOHNSON, P.
River Regulation: A Regional Perspective - Northumbrian Water Authority,
W89-00950 4A

JOHNSON, P. W.
Phagotrophic Phototrophs: The Ecological Significance of Mixotrophy,
W89-00384 2H

JOHNSON, W. K.
Funding Reserve Capacity in Wastewater Systems,
W89-00506 5D

JOHNSTON, A. J.
Horizontal Round Buoyant Jet in Shallow Water,
W89-00902 5E

JOHNSTON, C. G.
Microbially Mediated Mn(II) Oxidation in an Oligotrophic Arctic Lake,
W89-00335 2H

JOHNSTON, D. M.
Issues in Rule Base Development,
W89-00305 6A

JOHNSTON, L. M.
Acidification of Shallow Groundwaters During the Spring Melt Period,
W89-00893 5B

JONASSON, R. G.
Surface Reactions of Synthetic, End-member Analogues of Monazite, Xenotime and Rhabdophane, and Evolution of Natural Waters,
W89-01080 2K

JONES, A.
Influence of Altitude on Wet Deposition: Comparison between Field Measurements at Great Dun Fell and the Predictions of a Seeder-Feeder Model,
W89-01147 5B

JONES, A. K.
Release of Micro-algal Photosynthate and Associated Bacterial Uptake and Heterotrophic Growth,
W89-01187 2H

JONES, K.
Phytoplankton Ecology of the Firth of Clyde Sea-Lochs Striven and Fyne,
W89-00813 2L

JONES, R. M.
Determination of Fluoride Ion in Well Waters of Eastwood School District, Wood County, Ohio,
W89-00684 5A

JONES, R. N.
Habitat Use of Two Darter Species in Glover River, Oklahoma,
W89-00396 2H

JONSSON, B.
Distribution of Chlorinated Organic Substances from Pulp Mills,
W89-00359 5B

JONSSON, E.
Population Dynamics and Production of Chironomidae (Diptera) at 2 m depth in Lake Esrom, Denmark,
W89-00182 2H

JONSSON, P.
Distribution of Chlorinated Organic Substances from Pulp Mills,
W89-00359 5B

JORDAHL, D. M.
Effect of Low pH on Survival of Brook Trout Embryos and Yolk-Sac Larvae in West Virginia Streams,
W89-00293 5C

JOSEPH, J. H.
Vertically Integrated Snow/Ice Model over Land/Sea for Climate Models: 1. Development,
W89-01260 2C

Vertically Integrated Snow/Ice Model over Land/Sea for Climate Models: 2. Impact on Orbital Change Experiments,
W89-01261 2C

JOSHI, U. M.
Biochemical Changes in the Liver of Fish, Tilapia mossambica (Peters), during Continuous Exposure to Monocrotophos,
W89-00085 5C

JOUANNEAU, J. M.
Suspended Matter and Bottom Deposits in the Mahury Estuarine System (French Guiana): Environmental Consequences,
W89-00003 2J

JOYCE, J. C.
Effect of Gibberellic Acid and 2,4-D on Water Hyacinths,
W89-00105 4A

JUETTNER, F.
Motor-Boat-Derived Volatile Organic Compounds (VOC) in Lake water,
W89-00499 5B

JULIEN, P. Y.
Laboratory Analysis of Mudflow Properties,
W89-00899 2J

Suspension of Large Concentrations of Sands,
W89-00900 2J

JUNCAI, Z.
Hydrological Features of Poyang Lake (II), (in Chinese),
W89-00535 2H

Hydrological Features of Poyang Lake, (in Chinese),
W89-00532 2H

JURKOWSKA, J.
Estimation of Phytoplankton Biomass and Production, and Organic Matter Decomposition in Three Small Field-Ponds,
W89-00252 2H

JYOTI, M. K.
Thermal Ecology of Surinsar, a Subtropical Freshwater Lake in Jammu, India,
W89-00242 2H

KABASAKALIS, B.
Boron Levels in Some Ground Waters of Halkidiki (A Land at Northern Aegean Sea),
W89-00569 5B

KABAT, P.
Modelling Soil Water Dynamics in the Unsaturated Zone: State of the Art,
W89-01014 2G

KAESLER, R. L.
Effect of a Heated Wastewater Discharge upon River Protozoan Species Pool Variability through Time and Space,
W89-00077 5C

KAGI, R. I.
Controlling Swampy Odors in Drinking Water,
W89-00425 5F

KAISER, K. L.
Estimating the Acute Toxicity of Waterborne Chemicals in Trout from Measurements of Median Lethal Dose and the Octanol-Water Partition Coefficient,
W89-01095 5C

KAJARY, I.
Water Quality of the Tisza River and the Alpar Backwater,
W89-00143 5B

KAJIKAWA, M.
Characteristic Features of Supercooled Raindrops in the Mid-Winter Season of Arctic Canada,
W89-00418 2B

KALFF, J.
Influence of Sediment Composition and Irradiance on the Growth and Morphology of Myriophyllum spicatum L.,
W89-00098 2H

KALINKEVICH, D. A.
Characteristics of the Organization and Performance of Works in the Dam Foundation of the Al-Hadithah Hydro Development (Iraq),
W89-01182 8F

KALLIOKOSKI, P.
Effect of Permanganate Oxidation and Chlorination on the Mutagenic Activity and other Quality Parameters of Artificially Recharged Ground Water Processed from Humus-rich Surface Water,
W89-00599 5F

KAMEL, M.
Incidence of Coliphage in Potable Water Supplies,
W89-00338 5F

KANARSKII, V. F.
Effect of Seepage on Earth Dams,
W89-00550 8D

Filterless Revetment of the Slopes of Dikes at Pumped-storage Station Reservoirs,
W89-00058 8A

KANEKO, S.
Phosphorus Removal by Crystallization Using a Granular Activated Magnesia Clinker,
W89-01126 5D

KANIEWSKA-PRUS, M.
Indicatory Role of Some Invertebrates for Quality of Water in the Vistula River and in Subsequent Stages of Its Treatment,
W89-00236 5A

KANIUKA, R. P.
Encapsulated Herbicides Could Curb Ground Water Pollution,
W89-00964 5G

KANN, E.
Benthic Cyanophyte Associations in Streams and Lakes (Benthische Cyanophyten-Gemeinschaften in Bachen und Seen),
W89-00184 2H

Could Benthic Algae be used as Water Quality Indicators (Konnen Benthische Algen zur Wassergute-Bestimmung Herangezogen Werden),
W89-00194 5A

KAPLAN, P. G.
Single-Well Tracing Method for Estimating Regional Advective Velocity in a Confined Aquifer: Theory and Preliminary Laboratory Verification,
W89-00707 2F

KARADIMITRIS, T.
Cotton Yarn and Fabric Finishing Wastewater Treatment in Upflow Anaerobic Filter,
W89-00277 5D

KARAMCHANDANI, P. K.
Testing a Comprehensive Acid Deposition Model,
W89-00310 5B

KARAS, P.
Effects of a Bleached Pulp Mill Effluent on Growth and Gonad Function in Baltic Coastal Fish,
W89-00367 5C

Effects of Pulp Mill Effluent on a Baltic Coastal Fish Community,
W89-00366 5C

KARLINGER, M. R.
Regression Estimates for Topological-Hydrograph Input,
W89-00304 2E

KARLYKHANOV, O. K.
Regularities in the Formation of Curved Channels,
W89-00041 2J

KARR, J. R.
Spatial and Temporal Variability of the Index of Biotic Integrity in Three Midwestern Streams,
W89-00026 2E

KARTELEV, B. G.
Experience in Operating Hydraulic Structures and Equipment of Hydroelectric Stations,
W89-00554 8C

KARTSONAS, N.
Assessment of the Toxicity of Heavy Metals to the Anaerobic Digestion of Sewage Sludge,
W89-00631 5D

KASHIMOTO, T.
Monitoring of PCDDs in Osaka Bay Using Blue Mussel,
W89-00604 5B

Polybrominated Biphenyl Ethers in Marine Fish, Shellfish, and River and Marine Sediments in Japan,
W89-00610 5B

KASIMIR, G. D.
Detection and Enumeration of Actinomycetes in the Austrian Part of the Danube by Means of Selective Membrane Filtration Methods Together With Some Other Bacteriological Parameters (Nachweis und Vorkommen von Actinomyceten in der osterreichischen Donau mittels selektiver Membranfilterverfahren, zusammen mit einigen anderen bakteriologischen Parametern),
W89-00174 5A

KATINIC, J. J.
Kinetics of Sulfide Oxidation by Dissolved Oxygen,
W89-01130 5D

KATOPODIS, C.
Plunging and Streaming Flows in Pool and Weir Fishways,
W89-00904 2E

KAVANAGH, B. V.
Controlling Swampy Odors in Drinking Water,
W89-00425 5F

Kinetics of Sulfide Oxidation by Dissolved Oxygen,
W89-01130 5D

KAVANAUGH, M.
Coping with Groundwater Contamination,
W89-01135 5G

KAVLENTIS, E.
Treatment of Dye-Containing Effluents with Different Bentonites,
W89-00615 5D

KAWAI, H.
Diurnal Changes of pH Distribution and the Cascading of Shore Water in a Sargassum Forest,
W89-00682 2L

KAWAMURA, S.
Improving Water Supply in Thailand,
W89-00422 5F

KEANE, R. D.
Horizontal Round Buoyant Jet in Shallow Water,
W89-00902 5E

KEDUO, C.
Effects of Six Heavy Metals on Hatching Eggs and Survival of Larva of Marine Fish, (in Chinese),
W89-00533 5C

KEEFER, G. B.
Land Application of Domestic Wastewater, Wood Production, and Sludge Composting: An Economic and Energy Production Analysis,
W89-00465 5E

KEEN, C. S.
Mesoscale Spiral Vortex Embedded within a Lake Michigan Snow Squall Band: High Resolution Satellite Observations and Numerical Model Simulations,
W89-00748 2B

KEENE, W. C.
Local Influences on the Composition of Precipitation on Bermuda,
W89-00405 2A

KEITH, J. A.
Organochlorines and Eggshell Thinning in Northern Gannets (Sula bassanus) from Eastern Canada, 1968-1984,
W89-01054 5C

KEIZER, P. D.
Adventures in Holistic Ecosystem Modelling: The Cumberland Basin Ecosystem Model,
W89-00675 2L

Nutrient Dynamics in Cumberland Basin - Chignecto Bay, A Turbid Macrotidal Estuary in the Bay of Fundy, Canada,
W89-00152 2L

KELLER, C. K.
Hydrogeology of Two Saskatchewan Tills. I. Fractures, Bulk Permeability, and Spatial Variability of Downward Flow,
W89-01201 2F

Hydrogeology of Two Saskatchewan Tills. II. Occurrence of Sulfate and Implications for Soil Salinity,
W89-01202 2F

KELLY, C. A.
Disruption of the Nitrogen Cycle in Acidified Lakes,
W89-00451 5C

KELLY, J. M.
Annual Elemental Input/Output Estimates for Two Forested Watersheds in Eastern Tennessee,
W89-01168 5B

Effects of Leaching and Whole-Tree Harvesting on Cation Budgets of Several Forests,
W89-01166 4C

KELSEY, D. A.
Toxic and Environmental Torts within Admiralty,
W89-00518 6E

KEMING, Q.
Catalytic Determination of Copper in Natural Water at Microgram/L Level by Flow Injection Analysis, (in Chinese),
W89-00201 7B

KENNEDY, K. J.
Anaerobic Treatment of Leachate Using Fixed Film and Sludge Bed Systems,
W89-01238 5D

KENOYER, G. J.
Tracer Test Analysis of Anisotropy in Hydraulic Conductivity of Granular Aquifers,
W89-00940 2F

KENT, B.
Historical Use of Ground Water in Terrell, Texas,
W89-00461 4B

KERANEN, P.
Effect of Permanganate Oxidation and Chlorination on the Mutagenic Activity and other Quality Parameters of Artificially Recharged Ground Water Processed from Humus-rich Surface Water,
W89-00599 5F

KERN, S.
Determination of Mono- and Divalent Cations and Anions in Small Fog Samples by Ion Chromatography,
W89-00372 5A

KERR, A. J.
Conservation of Natural Resources,
W89-00827 6E

KERSER, H. W.
Quality Control Approach to NPDES Compliance Determination,
W89-01136 5D

KESSLER, E.
Limits of Growth of Five Chlorella Species in the Presence of Toxic Heavy Metals,
W89-00191 5C

KETTRUP, A.
Determination of Phenoxy Acid Herbicides in Water Samples,
W89-00576 5A

KHADER, K. Y. H.
Multi-Component Sorption Isotherms of Basic Dyes onto Peat,
W89-00083 5D

KHAMITOV, I. K.
Effective Coatings for Hydraulic Structures,
W89-00075 8G

KHAN, A. U.
Flow Simulation Using Channel Network Model,
W89-00751 7B

KHAN, H. U.
Flow Simulation Using Channel Network Model,
W89-00751 7B

KHAN, I. S. A. N.
Solubilities of Trace Copper and Lead Species and the Complexing Capacity of River Water in the Linggi River Basin,
W89-00084 5B

KHAN, S. M.
Flow Simulation Using Channel Network Model,
W89-00751 7B

KHANBILVARDI, R. M.
Dempster's Rule of Combination in Soil-Loss Prediction,
W89-00303 2J

KHANGAROT, B. S.
Sensitivity of Freshwater Pulmonate Snails, Lymnaea luteola L., to Heavy Metals,
W89-01154 5C

KHESIN, G. L.
Seismic Stress State of Underground Structures with Consideration of the Effect of the Free Surface,
W89-00035 8E

KHLOPENKOV, P. R.
Improvement of the Effectiveness of Spillway Operation of High-Head Hydroelectric Stations,
W89-00067 8B

KHO, E. B.
Distribution of Arsenic in the Sediments and Biota of Hilo Bay, Hawaii,
W89-00677 5B

KIELLAND, K.
Productivity and Nutrient Cycling of Alaskan Tundra: Enhancement by Flowing Soil Water,
W89-00908 2G

KIESSER, S.
Sea-Surface Microlayer of Puget Sound: Part I: Toxic Effects on Fish Eggs and Larvae,
W89-00853 5C

KIESSER, S. L.
Laboratory Study of the Accumulation and Toxicity of Contaminants at the Sea Surface from Sediments Proposed for Dredging,
W89-00858 5E

KIKUCHI, K.
Characteristic Features of Supercooled Raindrops in the Mid-Winter Season of Arctic Canada,
W89-00418 2B

KIKUCHI, K.

Experiments on Seawater Desalination by Membrane Distillation,
W89-01063 3A

KILLINGBECK, K. T.
Biomass, Productivity and Life History Traits of Juncus militaris Bigel. in Two Rhode Island (U.S.A.) Freshwater Wetlands,
W89-00100 2H

KINCAID, S. M.
Cities Supported by Sticks in the Mud: A Variation on the Settlement of Land and Structures Caused by Ground Water Removal,
W89-01190 6E

KING, G. M.
Patterns of Sulfate Reduction and the Sulfur Cycle in a South Carolina Salt Marsh,
W89-01046 2K

KIPPHUT, G. W.
Microbially Mediated Mn(II) Oxidation in an Oligotrophic Arctic Lake,
W89-00335 2H

KIRCHESCH, V.
Impact of Impounding on the Oxygen Balance of the Danube from Kelheim to Jochenstein Microbiological-Biochemical Investigations and Water Quality Model Calculations (Zum Einfluss der Strauregulierung auf den Sauerstoffhaushalt der Donaustrecke Kelheim-Jochenstein: Mikrobiologisch-biochemische Untersuchungen und Gutemodellrechnungen),
W89-00173 6G

KIRCHMAN, D. L.
Estimating Bacterial Production in Marine Waters from the Simultaneous Incorporation of Thymidine and Leucine,
W89-00729 7B

KIRKBY, M.
Hillslope Runoff Processes and Models,
W89-01022 2A

KITANIDIS, P. K.
Gradient Dynamic Programming for Stochastic Optimal Control of Multidimensional Water Resources Systems,
W89-00979 6A

KITTREDGE, D.
GAC Treatment Cost Experience at Two Drinking Water Utilities,
W89-00495 5F

KJARTANSON, B. H.
Creep of Ice Measured with the Pressuremeter,
W89-00387 2C

KLAFTER, J.
Feeding and Swimming Behavior in Grazing Microzooplankton,
W89-00382 2H

KLAMBERG, H.
Degradation of Polycyclic Aromatic Hydrocarbons: III. Reaction Products of the Ozonolysis of Further Polycyclic Aromatic Hydrocarbons in Aqueous Systems (Zum Abbau von Polycyclischen Aromatischen Kohlenwasserstoffen: III. Reaktionsprodukte der Umsetzung von Weiteren Polycyclischen Aromatischen Kohlenwasserstoffen in Wasser mit Ozon),
W89-00739 5F

KLAR, L. R.
Recreation Resource Allocation Model for Public Drinking Reservoirs,
W89-00921 6D

KLAUDA, R. J.
Comparative Sensitivities of Bluegill, Channel Catfish and Fathead Minnow to pH and Aluminum,
W89-01098 5C

KLEE, R.
Phytoplankton Studies of Slowly Running Waters: Rivers Danube and Vils (Phytoplanktonstudien an langamfliessenden Gewassern: Donau und Vils),
W89-00172 2E

KLEMES, V.
Hydrological Perspective,
W89-01011 2A

KLINE, E. R.
Acute and Chronic Toxicity of Triphenyltin Hydroxide to Fathead Minnows (Pimephales promelas) Following Brief or Continuous Exposure,
W89-01057 5C

KLITTICH, W. M.
Comparison of Two Methods for Summarizing Hydraulic Conductivities of a Layered Soil,
W89-00970 2G

KLOCKOW, D.
Evaluation of the Sulfur(IV) Catalyzed Autoxidation of Cobalt(II) in an Azide Containing Medium as a Means for the Determination of Sulfite in Precipitation,
W89-00736 5A

KLOSOWSKI, S.
Habitat Requirements and Bioindicator Value of the Main Communities of Aquatic Vegetation in North-East Poland,
W89-00235 2H

KLOTZ, P. H.
Baseline Study of Jordan Creek, City of Allentown, Lehigh County, Pennsylvania,
W89-00313 5C

KLUTE, A.
Improved Methodology for a Collinear Dual-Energy Gamma Radiation System,
W89-00985 7B

KNAP, A. H.
Local Influences on the Composition of Precipitation on Bermuda,
W89-00405 2A

Occurrence and Distribution of Trace Organic Compounds in Bermuda Precipitation,
W89-01148 5B

KNAPP, L. K.
Evaluation of Disposable Membrane Filter Units for Sorptive Losses and Sample Contamination,
W89-00623 5A

KNAUS, R. M.
Chromium Removal from Water by Three Species of Duckweeds,
W89-00109 5D

KNIGHT, A. W.
Nutrient and Light Limitation of Algae in Two Northern California Streams,
W89-00296 2H

KNORR, D. F.
Periphyton, Benthic Invertebrates and Fishes as Biological Indicators of Water Quality in the East Branch Brandywine Creek,
W89-00314 5A

KNOWLES, R.
Toxicity of Alkyllead Salts to Anaerobic Nitrogen Transformations in Sediment,
W89-01167 5C

KNUTH, M. L.
Acute and Chronic Toxicity of Triphenyltin Hydroxide to Fathead Minnows (Pimephales promelas) Following Brief or Continuous Exposure,
W89-01057 5C

KOCAN, R.
Sea-Surface Microlayer of Puget Sound: Part I: Toxic Effects on Fish Eggs and Larvae,
W89-00853 5C

Toxicity of Sea-Surface Microlayer: Effects On Herring and Turbot Embryos,
W89-00855 5C

KOCAN, R. M.
Toxicity of Sea-Surface Microlayer: Effects of Hexane Extract on Baltic Herring (Clupea harengus) and Atlantic Cod (Gadus morhua) Embryos,
W89-00856 5C

KODRIC-SMIT, M.
Polychlorinated Biphenyls in the Kupa River, Croatia, Yugoslavia,
W89-00609 5B

KOELLIKER, J.
Contamination of Farmstead Wells by Pesticides, Volatile Organics, and Inorganic Chemicals in Kansas,
W89-00946 5B

KOJIC, S. B.
Transient Pressures in Hydrotechnical Tunnels During Earthquakes,
W89-00448 8E

KOK, C. J.
Ammonium and Nitrate Uptake by Aquatic Plants from Poorly Buffered and Acidified Waters,
W89-00112 5C

KOKKINN, M. J.
Flux of Organic Carbon in a Tidal Salt Marsh, Kowie River Estuary, Port Alfred, South Africa,
W89-00453 2L

KOKSVIK, J. I.
Limnocorral Experiments in a Eutrophic Lake - Effects of Fish on the Planktonic and Chemical Conditions,
W89-00253 2H

KOLLIG, H. P.
Estimate of the Variability in Biotransformation Kinetics of Xenobiotics in Natural Waters by Aufwuchs Communities,
W89-00559 5B

KOLSET, K.
Evaluation of the 'Fugacity' (FEQUM) and the 'EXAMS' Chemical Fate and Transport Models: A Case Study on the Pollution of the Norrsundet Bay (Sweden),
W89-00357 5B

KOMAREK, J.
SEM-Analysis of Colonies of the Cyanophyte Nodularia Water Bloom from Baltic Sea,
W89-00193 2H

KOMATSU, T.
Diurnal Changes of pH Distribution and the Cascading of Shore Water in a Sargassum Forest,
W89-00682 2L

KOMEL'KOV, L. V.
Evaluation of the Reliability of Wave-Protection Slab Revetments of Embankment Slopes,
W89-01176 8D

KONDOU, K.
Nitrogen Metabolism in the Brackish Lake Nakanoumi. III. Nitrification-Dentrification in Low Concentration of Dissolved Oxygen, (in Japanese),
W89-00769 2H

KONDRAT'EV, V. M.
Filterless Revetment of the Slopes of Dikes at Pumped-storage Station Reservoirs,
W89-00058 8A

KONIKOW, L. F.
Groundwater Flow and Transport Modeling,
W89-01025 2F

KONINGS, S. A.
Distribution of Chitinolytic Bacteria in Various Aquatic Systems: A Comparative Study,
W89-00402 2H

KONYHA, K. D.
Evaluating Peat-Mining Hydrology Using DRAINMOD,
W89-00755 4C

KOORNHOF, H. J.
Legionnaire's Disease in a Johannesburg Teaching Hospital,
W89-00450 5F

KOPPE, M.
Isotope Ratio Measurements of Mo, V, Ti, and Zr and the Determination of These Elements in Water Samples with a Thermal Ionization Quadrupole Mass Spectrometer (Isotopenverhaltnismessung von Mo, V, Ti und Zr Sowie Deren Konzentrationsbestimmung in Wassern Mit Einem Thermionen-Quadrupol-Massenspektrometer),
W89-00267 5A

KORDIK, E.
Phosphorus Determination in Rivers (Phosphor in Fliessgewaessern und Seine Analytische Bestimmung),
W89-00735 5A

KORSHOLM, E.
Activity Assessment in Drinking Water Bacteriology - A Comparison of Methods and Possibilities,
W89-00928 5A

KORTHALS, E. T.
Comparison of Chemical Biodegradation Rates in BOD Dilution and Natural Waters,
W89-01158 5B

Effects of Acidification on Mercury Methylation, Demethylation, and Volatilization in Sediments from an Acid-Susceptible Lake,
W89-00731 5B

KORZENIEWSKI, K.
Chlorophyll Relationships in Letowo and Szczytno Male Lakes, with Trout Cage Culture,
W89-00262 2H

Hydrochemical Study of Lake Szczytno Male With Trout Cage Culture,
W89-00241 5B

Sorption of Cations by Bottom Sediments of Szczytno Male and Letowo Lakes, with Cage Trout Culture,
W89-00239 2H

KOSSON, D. S.
Design Criteria for In-Situ and On-Site Renovation of an Industrial Sludge Lagoon,
W89-00996 5B

KOSTIN, I. K.
Seismic Stress State of Underground Structures with Consideration of the Effect of the Free Surface,
W89-00035 8E

KOTZIAS, D.
Formation of Oxygen Species and Their Reactions with Organic Chemicals in Aqueous Solution,
W89-00575 5B

KOUIMTZIS, T. A .
Preconcentration of Heavy Metals in Natural Waters with Hydrazones Supported on Silica Gel,
W89-00568 5A

KOUZELI-KATSIRI, A.
Assessment of the Toxicity of Heavy Metals to the Anaerobic Digestion of Sewage Sludge,
W89-00631 5D

KOVACS, A.
Tisza Water, as Irrigation Water, Polluted with Various Compounds,
W89-00145 3C

KOVACS, K.
Seasonal Composition, Biomass and Primary Productivity of the Phytoplankton in Lakitelek Backwater during 1980 and 1983,
W89-00144 2H

KOWALEWSKA, G.
Influence of the Vistula River on Distribution of 226Ra in the Gdansk Bay,
W89-00250 2K

KRAEHENBUEHL, U.
Reactor Accident at Chernobyl: A Possibility to Test Colloid-Controlled Transport of Radionuclides in a Shallow Aquifer,
W89-00990 5B

KRASIL'NIKOV, N.A.
Selection of a Method for Computer-aided Design of Earth Dams,
W89-00056 8D

KRASNIK, I. L.
Reconstruction of the Surge Tank of the Sengilei Hydroelectric Station,
W89-00546 8C

KREJCA, M.
Infiltration under Ponded Conditions: 2. Infiltration Equations Tested for Parameter Time-Dependence and Predictive Use,
W89-00740 2G

KRIEGER, K. A.
Snail Distributions in Lake Erie: The Influence of Anoxia in the Southern Central Basin Nearshore Zone,
W89-00683 2A

KRINGSTAD, A.
Methods for Determination of Sum Parameters and Characterization of Organochlorine Compounds in Spent Bleach Liquors from Pulp Mills and Water, Sediment and Biological Samples from Receiving Waters,
W89-00358 5A

KRINGSTAD, K. P.
Fate of Spent Bleach Liquor Material in Receiving Waters: Characterization of Chloroorganics in Sediments,
W89-00371 5B

KRISHNAMOORTHY, R.
Terrestrial Bioaccumulation Potential of Phenolic Compounds,
W89-00998 5B

KRISTIANSEN, S.
Nitrate Reductase Activity in Phytoplankton from the Oslo-fjord, Norway,
W89-00226 2H

KRUIZINGA, S.
Model Output Statistics Forecasts: Three Years of Operational Experience in the Netherlands,
W89-00843 2B

KRUSI, B. O.
Experimental Studies on the Resiliency of Floating Typha Mats in a Freshwater Marsh,
W89-00287 2H

KRYSTINIK, L. F.
Stokes Surfaces and the Effects of Near-Surface Groundwater-Table on Aeolian Deposition,
W89-00410 2J

KUBOTA, S.
Experiments on Seawater Desalination by Membrane Distillation,
W89-01063 3A

KUCZERA, G.
General Water Supply System Simulation Model: WASP,
W89-00299 5F

KUDO, I.
Distribution of Cadmium in Lake Tohya,
W89-00774 2H

KUEHL, D. W.
Bioavailability of Polychlorinated Dibenzo-p-dioxins and Dibenzofurans from Contaminated Wisconsin River Sediment to Carp,
W89-00583 5B

KUHLMANN, D. H. H.
Sensitivity of Coral Reefs to Environmental Pollution,
W89-00440 5C

KUKKONEN, J.
Acclimatization of Roach, Rutilus rutilus (L.), to Toxic Components of Kraft Pulp Mill Effluents,
W89-00087 5C

KULAKOV, A. E.
Optimization of the Mud Intakes of Dredges with Submersible Pumps,
W89-00044 8C

KULKANI, S.
Simplified Turbine Runner Shows Good Cavitation Resistance,
W89-01003 8C

KUMAR, D.
Heavy-Metal Toxicity in the Cyanobacterium Nostoc linckia,
W89-00094 5C

KUMAR, H. D.
Heavy-Metal Toxicity in the Cyanobacterium Nostoc linckia,
W89-00094 5C

KUMAR, N.
Impact of Manganese Intoxication on the Blood Pyruvic Acid of a Freshwater Tropical Perch Colisa fasciatus,
W89-00263 5A

KUMMEROW, C.
Determining Microwave Brightness Temperatures from Precipitating Horizontally Finite and Vertically Structured Clouds,
W89-01263 7B

KUO, C.-J.
Factors Affecting Coagulation with Aluminum Sulfate: I. Particle Formation and Growth,
W89-01221 5F

Factors Affecting Coagulation with Aluminum Sulfate: II. Dissolved Organic Matter Removal,
W89-01222 5F

KUO, J. T.
Programming Model for the Optimal Planning of Water Supply Systems,
W89-00452 6A

KUPRIK, A. A.
Modification of Turbine Runner Blades at the Chirkey Hydroelectric Station,
W89-00555 8C

KUROSHEV, G. D.
Experience in Determining the Numerical Characteristics of Landslide Movements,
W89-00551 8A

KUSAKABE, M.
Relationship Between delta-D and delta-18-O Values of Falling Snow Particles from a Separate Cloud,
W89-00406 2C

KUTILEK, M.
Infiltration under Ponded Conditions: 2. Infiltration Equations Tested for Parameter Time-Dependence and Predictive Use,
W89-00740 2G

KYEYUNE, G.
Guinea Worm Disease in Northern Uganda: A Major Public Health Problem Controllable Through an Effective Water Programme,
W89-00278 5F

LACOUTURE, R. V.
Effects of Increasing Salinity on a Cyanobacteria Bloom in the Potomac River Estuary,
W89-00231 2H

LALL, U.
Optimization Model for Screening Multipurpose Reservoir Systems,
W89-00703 6A

LAMB, M. A.
Effects of Current Velocity on the Physical Structuring of Diatom (Bacillariophyceae) Communities,
W89-00686 2E

LAMBECK, R. H. D.
Distribution, Dynamics and Productivity of a Colonizing (Polydora quadrilobata) and an Established (P. ligni) Polydorid Polychaete in Lake Grevelingen: An Enclosed Estuary in the SW Netherlands,
W89-00002 2H

LAMBERT, A.
Records of Riverborne Turbidity Currents and Indications of Slope Failures in the Rhone Delta of Lake Geneva,
W89-01049 2J

Regulation of the River Dee,
W89-00953 4A

LANDMAN, K. A.
Contaminant Transport in Fractured Porous Media: Steady State Solutions by a Boundary Integral Method,
W89-00982 5B

LANDMARK, L. H.
Investigations of Chlorinated Thiophenes: A Group of Bioaccumulable Compounds Identified in the Effluents from Kraft Bleaching,
W89-00360 5B

LANDOLT, M.
Toxicity of Sea-Surface Microlayer: Effects On Herring and Turbot Embryos,
W89-00855 5C

LANDOLT, M. L.
Hepatic Lesions in English Sole (Parophrys vetulus) from Commencement Bay, Washington (USA),
W89-00859 5C

Toxicity of Sea-Surface Microlayer: Effects of Hexane Extract on Baltic Herring (Clupea harengus) and Atlantic Cod (Gadus morhua) Embryos,
W89-00856 5C

LANG, G. E.
Cycling of Inorganic and Organic Sulfur in Peat from Big Run Bog, West Virginia,
W89-00208 2H

LANG, P. C.
Eutrophication and Benthic Fauna of Three Mountain Lakes (Eutrophisation et Faune Benthique de Trois Lacs de Montagne),
W89-00695 5C

LANGELAND, A.
Limnocorral Experiments in a Eutrophic Lake - Effects of Fish on the Planktonic and Chemical Conditions,
W89-00253 2H

LANGI, A.
Mutagenicity in Pulp and Paper Mill Effluents and in Recipient,
W89-00370 5C

LANYING, H.
Effects of Six Heavy Metals on Hatching Eggs and Survival of Larva of Marine Fish, (in Chinese),
W89-00533 5C

LANZER, R. M.
Freshwater Mollusks as Indicators of Trophic Conditions in Coastal Lakes of Southern Brazil (Moluscos Dulceaquicolas Como Indicadores de Condicoes Troficas em Lagoas Costeiras do Sul do Brasil),
W89-00008 5A

LARGE, R.
Degradation of Low-Toxicity Oil-Based Drilling Mud in Benthic Sediments around the Beatrice Oilfield,
W89-00792 5B

LAROSA, F.
Definition of a Model for Monitoring the Chemical and Chemical-Physical Characteristics of Deep Drinking Waters,
W89-00927 7C

LARSON, R. A.
Reactivity of the Carbonate Radical with Aniline Derivatives,
W89-01088 5B

Sequential Wet Air Regeneration of PAC from the Powdered Carbon-Activated Sludge Process,
W89-01137 5D

LARSSON, A.
Physiological Disturbances in Fish Exposed to Bleached Kraft Mill Effluents,
W89-00363 5C

LARSSON, P.
Microbial Degradation of Xenobiotic, Aromatic Pollutants in Humic Water,
W89-00344 5B

LAU, E. F. C.
Development and Management of Groundwater Resources on Diego Garcia,
W89-00423 4B

LAUT, P.
Landscape and Rainfall Indices for Prediction of Streamflow Similarities in the Hunter Valley, Australia,
W89-00972 2E

LAWRENCE, B. J.
Effects of Acute Exposure to Acidified Water on the Behavorial Response of Fathead Minnows, Pimephales Promelas, to Alarm Substance (Schreckstoff),
W89-01092 5C

LAWS, E. A.
Effects of Polyculture and Manure Fertilization on Water Quality and Heterotrophic Productivity in Macrobrachium rosenbergii Ponds,
W89-00327 8I

LAY, J. P.
Influence of Chemicals upon Plankton in Freshwater Systems,
W89-00581 5C

LAYHER, W. G.
Relations Between Habitat Variables and Channel Catfish Populations in Prairie Streams,
W89-00325 2H

LAZAR, L.
Viral Pollution of Surface Waters by Domestic Waste Water Discharge (Die Viral-Verunreinigung der Oberflachengewasser durch Ableiten der Haushaltsabwasser),
W89-00170 5B

LCZOBKO, G. A.
Prospects of Improving the Prediction of the Hazard of Rock Bursts During Tunneling,
W89-00038 8E

LEAITCH, W. R.
Winter Cloud Water and Air Composition in Central Ontario,
W89-01265 5C

LEAP, D. I.
Single-Well Tracing Method for Estimating Regional Advective Velocity in a Confined Aquifer: Theory and Preliminary Laboratory Verification,
W89-00707 2F

LEBEL, T.
Rain Measurement by Raingage-Radar Combination: A Geostatistical Approach,
W89-00761 7B

LEDGER, D. C.
Runoff Generation in a Plough-drained Peat Bog in Southern Scotland,
W89-00345 4C

LEDUC, L. G.
Statistical Considerations Associated with the Use of the Heterotrophic Activity Method for Estimating V sub max and K' for Aquatic Environments,
W89-00280 7C

LEE, D.
Evaluation of Vegetation Filter Strips as a Best Management Practice for Feed Lots,
W89-01125 5G

LEE, D. H.
Determinations of Suspended Sediment Concentrations from Multiple Day Landsat and AVHRR Data,
W89-00064 7B

LEE, R.
Lake Treatment with Alum,
W89-00745 5G

LEE, R. G.
Occurrence of Radon in Well Supplies,
W89-01105 5B

LEE, T. F.
Winter Diurnal Trends of Sierra Nevada Supercooled Liquid Water and Precipitation,
W89-00089 3B

LEE, Y. W.
Nitrate Removal from Water Supplies Using Biological Denitrification,
W89-01237 5F

LEICHTFRIED, M.
Determination of Organic Matter in River Sediments,
W89-00169 7B

LEITH, I. D.
Influence of Altitude on Rainfall Composition at Great Dun Fell,
W89-01146 5B

LEMCKE, C.
Model Output Statistics Forecasts: Three Years of Operational Experience in the Netherlands,
W89-00843 2B

LEMLEY, A. T.
Sorption and Degradation of Aldicarb and Its Oxidation Products in a Soil-Water Flow System as a Function of pH and Temperature,
W89-01164 5B

LENCE, B. J.
Cost Efficiency of Transferable Discharge Permit Markets for Control of Multiple Pollutants,
W89-00697 5G

LENZ, P. H.
Spatial and Temporal Distribution Patterns of Three Trophic Levels in a Saline Lake,
W89-00219 2H

LEONARD, P. M.
Application and Testing of an Index of Biotic Integrity in Small, Coolwater Streams,
W89-00323 2H

LEONOV, M. P.
Use of Hydrogeochemical Sampling Data in Hydraulic Engineering,
W89-01178 2F

LEONZIO, C.
Variations in Polychlorinated Biphenyl Congener Composition in Eggs of Mediterranean Water Birds in Relation to their Position in the Food Chain,
W89-01056 5B

LEPISTO, A.
Modelling the Effects of Acid Deposition: Estimation of Long-Term Water Quality Responses in Forested Catchments in Finland,
W89-00894 5B

LERMAN, A.
Background Aspects of Lake Restoration: Water Balance, Heavy Metal Content, Phosphorus Homeostasis,
W89-00014 2H

LEROUEIL, S.
Physicochemical and Geotechnical Characteristics of Recent Saguenay Fjord Sediments,
W89-00390 2J

LESAFFRE, B.
Subsurface Drainage Peak Flows in Shallow Soil,
W89-00749 4A

LESSARD, P.
Dynamic Modeling of Primary Sedimentation,
W89-00483 5D

LESTER, J. N.
Review of the Behaviour and Utilization of Polycarboxylic Acids as Detergent Builders,
W89-00620 5D

LESTER, W. W.
Effects of Light and Temperature on Photosynthesis of the Nuisance Alga Cladophora glomerata (L.) Kutz from Green Bay, Lake Michigan,
W89-00848 2H

LETTENMAIER, D. P.
Multivariate Nonparametric Tests for Trend in Water Quality,
W89-00863 7C

LETTINGA, G.
Effect of Sulphide on the Anaerobic Degradation of Propionate,
W89-00625 5D

LEUENBERGER, C.
Aliphatic and Polycyclic Aromatic Hydrocarbons in Urban Rain, Snow and Fog,
W89-00309 5B

Seasonal and Temporal Changes of Organic Compounds in Rain and Snow,
W89-00429 5B

LEVANDOWSKY, M.
Feeding and Swimming Behavior in Grazing Microzooplankton,
W89-00382 2H

LEWIS, A. G.
Tidal Transport of Planktonic Copepods across the Sill of a British Columbia Fjord,
W89-00221 2L

LEWIS, G. D.
Polyethylene Glycol Precipitation for Recovery of Pathogenic Viruses, Including Hepatitis A Virus and Human Rotavirus, from Oyster, Water, and Sediment Samples,
W89-00730 5A

LEWIS, M. A.
Impact of a Municipal Wastewater Effluent on Water Quality, Periphyton, and Invertebrates in the Little Miami River Near Xenia, Ohio,
W89-00685 5C

LEWIS, R. E.
Hydrography of Irvine Bay and Its Relation to the Clyde Sea Area,
W89-00805 2L

LEWIS, T. E.
Basic Encoded Model for One-Dimensional Ground Water Systems Incorporating First-Order Degradation Kinetics,
W89-00888 5B

Comparative Sensitivities of Bluegill, Channel Catfish and Fathead Minnow to pH and Aluminum,
W89-01098 5C

LEWIS, W. M.
Influence of pH and Ammonia Salts on Ammonia Toxicity and Water Balance in Young Channel Catfish,
W89-00377 5C

Primary Production in the Orinoco River,
W89-00907 2H

LEY, B.
Relative Roles of Emissions Changes and Meteorological Variability of Wet sulfur Deposition: A Trajectory Model Study,
W89-01259 5B

LI, J.
Trace Element Content in Drinking Water of Nasopharyngeal Carcinoma Patients,
W89-00048 5C

LIANG, G. C.
Identification of a Multiple Input, Single Output, Linear, Time Invariant Model for Hydrological Forecasting,
W89-01209 7C

LIANG, S.
Trace Element Content in Drinking Water of Nasopharyngeal Carcinoma Patients,
W89-00048 5C

LIGON, F. K.
Effects of Discharge Fluctuation and the Addition of Fine Sediment on Stream Fish and Macroinvertebrates Below a Water-Filtration Facility,
W89-01061 5C

LIIMATAINEN, A.
Effect of Permanganate Oxidation and Chlorination on the Mutagenic Activity and other Quality Parameters of Artificially Recharged Ground Water Processed from Humus-rich Surface Water,
W89-00599 5F

LIJUAN, H.
Determination of Trace Chromium in Natural Water by Polarographic Catalytic Wave Analysis, (in Chinese),
W89-00538 5A

LIJUN, H.
Studies on Marine Humic Substances: III. The Distribution of Humic Substances in Seawater and Sediments in the Estuary of Changjiang River and East China Sea, (in Chinese),
W89-00541 2L

Studies on Marine Humic Substances: IV. The Distribution of Humic Substances in the Seawater and Sediments of Huanghe River Estuary, (in Chinese),
W89-00545 2L

LIKENS, G. E.
Soil Processes and Sulfate Loss at the Hubbard Brook Experimental Forest,
W89-00206 5B

LILJESTRAND, H. M.
Interaction of Earthen Liner Materials with Industrial Waste Leachate,
W89-00997 5E

LIMA, N. R. W.
Contribution of Spartina alterniflora to the Pedra de Guaratiba (RJ) Salt Marsh Sediment Using Carbon-13 as a Tracer (Contribuicao de Materia Organica de Spartina alterniflora Para o Sedimento do Alagado de Pedra de Guaratiba (RJ): Uso de C13 como Tracador),
W89-00010 2L

LIME, D. W.
Identifying Critical Issues in Recreation Planning and Management: Improving the Management-Research Partnership,
W89-00873 6A

LINDAHL, O.
Large-Scale and Long-Term Variations in the Zooplankton Community of the Gullmar Fjord, Sweden, in Relation to Advective Processes,
W89-01038 2L

Short-Term Variations in the Zooplankton Community Related to Water Exchange Processes in the Gullmar Fjord, Sweden,
W89-00228 2H

LINDHOLM, C.
Microbial Pollution of Well Water in Southeastern Minnesota,
W89-00887 5B

LINDQVIST, K.
Sediments in the Estuarine Environment of the Tigris/Euphrates Delta; Iraq; Arabian Gulf,
W89-01083 2L

LINDSTROM, K.
Photosynthesis of Submersed Macrophytes in Acidified Lakes: II. Carbon Limitation and Utilization of Benthic CO2 Sources,
W89-00095 5C

LINGPING, W.
Analysis of the Effects of Suspended Sediment of Huanghe River on Harbor Construction by Using NOAA Images, (in Chinese),
W89-00536 2J

LINKINS, A. E.
Productivity and Nutrient Cycling of Alaskan Tundra: Enhancement by Flowing Soil Water,
W89-00908 2G

LISS, W. J.
Utility of Laboratory Streams for Ecosystem Toxicity Studies,
W89-01059 5B

LITTLE, K. T.
Dispersal and Recruitment of Fiddler Crab Larvae in the Delaware River Estuary,
W89-01039 2L

LO, H. H.
Performance of Vinyl Core Media Trickling Filter Plant for Secondary Treatment of Municipal Wastewater,
W89-00502 5D

LOAGUE, K. M.
Impact of Rainfall and Soil Hydraulic Property Information on Runoff Predictions at the Hillslope Scale,
W89-01246 2E

LOCAT, J.
Physicochemical and Geotechnical Characteristics of Recent Saguenay Fjord Sediments,
W89-00390 2J

LODENIUS, M.
Leaching of Mercury from Peat Soil,
W89-00592 5B

LOEHR, R. C.
Terrestrial Bioaccumulation Potential of Phenolic Compounds,
W89-00998 5B

LOEWENTHAL, R. E.
STASOFT: A User-Friendly Interactive Computer Program for Softening and Stabilisation of Municipal Waters,
W89-00935 5F

LOGAN, T. J.
Properties of Water Treatment Lime Sludges and Their Effectiveness as Agricultural Limestone Substitutes,
W89-00516 5F

LOGANATHAN, G. V.
Water Management for Lowland Rice Irrigation,
W89-00750 3F

LOMBARDO, V. N.
Calculation of an Arch Dam on the Basis of Solving the Three-dimensional Problem of the Theory of Elasticity and Theory of Shells,
W89-00057 8A

Deformation of Dams with a Facing and Their Seismic Stability,
W89-00070 8D

LONG, B. W.
SDWA Amendments: Small Community Compliance,
W89-01112 6E

LONG, S. C.
Aerobic Biodegradation of Natural and Xenobiotic Organic Compounds By Subsurface Microbial Communities,
W89-01090 5B

LONGTIN, J. P.
Occurrence of Radon, Radium, and Uranium in Groundwater,
W89-01108 5B

LOONG, N. S.
Petaling Jaya Non-Revenue Water Control Project Selangor, Malaysia,
W89-00923 5F

LOPEZ, M.
Summer Dynamics of the Deep Chlorophyll Maximum in Lake Tahoe,
W89-00224 2H

LORAH, M. M.
Chemical Evolution of a Travertine-Depositing Stream: Geochemical Processes and Mass Transfer Reactions,
W89-01250 2K

LORCH, H. J.
Scanning Electron Microscopy of Bacteria and Diatoms Attached to a Submerged Macrophyte in an Increasingly Polluted Stream,
W89-00132 5C

LOTHENBACH, D.
Bioavailability of Polychlorinated Dibenzo-p-dioxins and Dibenzofurans from Contaminated Wisconsin River Sediment to Carp,
W89-00583 5B

LOWE, R. L.
Effects of Current Velocity on the Physical Structuring of Diatom (Bacillariophyceae) Communities,
W89-00686 2E

LOWINGS, V. A.
River Regulation by Seasonal Groundwater Abstraction: The Case of the River Itchen,
W89-00956 4B

LOWRY, J. D.
Radionuclides in Drinking Water,
W89-01104 5B

LOWRY, S. B.
Radionuclides in Drinking Water,
W89-01104 5B

LOWTHION, D.
Role of Sewage Effluent in the Accumulation of Macroalgal Mats on Intertidal Mudflats in Two Basins in Southern England,
W89-00159 5C

LUCENA, F.
Relationship between Numbers of Enteroviruses and Bacteriophages Infecting Bacteroides fragilis in Different Environmental Samples,
W89-00645 5A

LUE-HING, C.
Effects of Discontinuing Disinfection on a Receiving Water,
W89-00515 5D

LUKATELICH, R. J.
Nutrient Levels and the Development of Diatom and Blue-Green Blooms in a Shallow Australian Estuary,
W89-00211 2H

LUNDGREN, A.
Model Ecosystems as a Tool in Freshwater and Marine Research,
W89-00180 5B

LUNG, W. S.
Modeling Blue-Green Algal Blooms in the Lower Neuse River,
W89-01225 5C

LUPI, S.
Definition of a Model for Monitoring the Chemical and Chemical-Physical Characteristics of Deep Drinking Waters,
W89-00927 7C

LUSSE, B.
Bromothymol-Blue Test: A Simple Algal Bioassay and its Use for Herbicide Screening,
W89-00192 5A

LUSTIG, K. W.
Innovative Septic System Management,
W89-00508 5D

LUSTY, E. W.
Avoidance of a Water-Soluble Fraction of Coal Liquid by Fathead Minnows,
W89-00321 5C

LUTZ, W.
Operational Models for Flood Calculations,
W89-01030 2A

LYAPIN, O. B.
Technology of Casting Precast Pipeline Elements of the Kaisiadory's Pumped-Storage Station,
W89-00045 8F

LYKINS, B. W.
GAC Treatment Cost Experience at Two Drinking Water Utilities,
W89-00495 5F

LYON, J. G.
Determinations of Suspended Sediment Concentrations from Multiple Day Landsat and AVHRR Data,
W89-00064 7B

LYONS, W. A.
Mesoscale Spiral Vortex Embedded within a Lake Michigan Snow Squall Band: High Resolution Satellite Observations and Numerical Model Simulations,
W89-00748 2B

LYONS, W. B.
Trace Metal Geochemistry of Pore Water Brines from Two Hypersaline Lakes,
W89-01079 2K

LYSIKOV, B. A.
Prospects of Improving the Prediction of the Hazard of Rock Bursts During Tunneling,
W89-00038 8E

LYTLE, J. S.
Lignin Residues as Tracers of Organic Waste Transport,
W89-00561 7B

LYTLE, T. F.
Lignin Residues as Tracers of Organic Waste Transport,
W89-00561 7B

MACCREHAN, W. A.
Determination of Hydrophilic Thiols in Sediment Porewater Using Ion-Pair Liquid Chromatography Coupled to Electrochemical Detection,
W89-00266 7B

MACDONALD, J. M.
Acute Toxicities of Eleven Metals to Early Life-History Stages of the Yellow Crab Cancer anthonyi,
W89-00386 5C

MACHIDA, D. T.
California Tahoe Conservancy: Applying the Principles,
W89-01068 6E

MACKAY, D.
Sorption of Hydrophobic Chemicals from Water: A Hypothesis for the Mechanism of the Particle Concentration Effect,
W89-00585 5B

Volume Fraction Correlation for Narcosis in Aquatic Organisms: The Key Role of Partitioning,
W89-01096 5C

MACKAY, D. W.
Migratory Salmonids of the Estuary and Firth of Clyde,
W89-00828 5G

MACLENNAN, A. S.
Oil Pollution in the Cromarty Firth and Inshore Moray Firth,
W89-00785 5B

MACPHERSON, J. R.
Discrete Point Sampler for Ground Water Monitoring Wells,
W89-00947 7B

MACQUITTY, M.
Pollution Beneath the Golden Gate,
W89-00852 5C

MAGAGNOLI, A.
Sediment-Water Core Sampler for Coastal Pollution Studies,
W89-00641 5A

MAGARITZ, M.
Microscale Haline Convection - A Proposed Mechanism for Transport and Mixing at the Water Table Region,
W89-00718 2F

MAGNUSSON, B.
Effects of Disturbances Along Hydroelectrical Transmission Corridors Through Peatlands in Northern Manitoba, Canada.
W89-00436 4C

MAHAJAN, B. A.
Mercury Pollution in the Estuarine Region around Bombay Island,
W89-00638 5B

MAINALI, A.
Plunging and Streaming Flows in Pool and Weir Fishways,
W89-00904 2E

MAJEWSKI, T. P.
Instrumentation for 7-Day Continuous Cycle Monitoring of Metals with Automated On-Line Sample Preparation, High-Performance Liquid Chromatography, and Electrochemical Detection,
W89-00210 5A

MAJONE, F.
Micronucleus Test: Examples of Application to Marine Ecology,
W89-01042 5A

MAKARAU, A.
Modified ATI Technique for Nowcasting Convective Rain Volumes over Areas,
W89-00090 2B

MAKENA, S.
Effects of Three Organics on Selected Physical Properties of Type I Portland Cement,
W89-00994 5E

MALECHA, S. R.
Effects of Polyculture and Manure Fertilization on Water Quality and Heterotrophic Productivity in Macrobrachium rosenbergii Ponds,
W89-00327 8I

MALES, R. M.
Contaminant Propagation in Distribution Systems,
W89-00494 5F

Modeling Contaminant Propagation in Drinking Water Distribution Systems,
W89-00929 5F

MALEVANCHIK, B. S.
Preservation of Natural Fish Reproduction during Hydrotechnical Construction on Rivers,
W89-00069 8I

MALLEVIALLE, J.
Chloropicrin in Potable Water: Conditions of Formation and Production during Treatment Processes (La Chloropicrine dans les Eaux Potables: Conditions de Formation et Evolution le long des Filieres de Traitement),
W89-00635 5F

MALM, O.
Heavy Metal Removal by Different Water Treatment Plants, in Rio de Janeiro State, Brazil,
W89-00647 5F

MALYSHEV, L. I.
Characteristics of the Organization and Performance of Works in the Dam Foundation of the Al-Hadithah Hydro Development (Iraq),
W89-01182 8F

MAN, C. S.
Creep of Ice Measured with the Pressuremeter,
W89-00387 2C

MANKA, J.
Trihalomethane Formation in High-Bromide Lake Galilee Water,
W89-00426 5F

MANN, R. H. K.
Fish and Fisheries of Regulated Rivers in the UK,
W89-00960 8I

MANNINEN, P.
Determination of Total Organic Chlorine and Bromine in Water Samples by Adsorption onto Activated Carbon and Neutron Activation Analysis,
W89-00588 5A

MANTOURA, R. F. C.
Nitrite and Ammonia in the Tamar Estuary,
W89-00154 5B

Sediment-Water Partition Coefficients and HPLC Retention Factors of Aromatic Hydrocarbons,
W89-00560 5B

MARA, D. D.
Fecal Coliform Fingertip Count: A Potential Method for Evaluating the Effectiveness of Low Cost Water Supply and Sanitation Initiatives,
W89-00379 5G

MARAIS, G. V. R.
STASOFT: A User-Friendly Interactive Computer Program for Softening and Stabilisation of Municipal Waters,
W89-00935 5F

MARGOLIN, A. B.
Characterization of the Interaction Between Viruses and a Solid Polymeric Contact Disinfectant,
W89-00884 5F

MARGRAF, F. J.
Eutrophication Effects of Prey Size and Food Available to Yellow Perch in Lake Erie,
W89-00030 5C

MARK, D. J.
Determinations of Suspended Sediment Concentrations from Multiple Day Landsat and AVHRR Data,
W89-00064 7B

MARKER, A. F. H.
Studies on Epilithic and Epiphytic Diatoms in a Chalkstream: Comparative Estimates of Chlorophyll a and Its Derivatives,
W89-01186 2H

MARKIN, V. N.
Adjusting and Modernization of the System Converting Units to Synchronous Capacitor Operation at the Sayano-Shushenskoe Hydroelectric Station,
W89-00074 8C

MARR, J. K.
Load Allocation for Toxics Using Monte Carlo Techniques,
W89-00514 5G

MARROCCO, F. A.
Role of the States in Solving the Small System Dilemma,
W89-01111 6E

MARSH, P.
Evaporation from Mackenzie Delta Lakes, N.W.T., Canada,
W89-00438 2D

MARSHALL, W. D.
Toxicity of Alkyllead Salts to Anaerobic Nitrogen Transformations in Sediment,
W89-01167 5C

MARTIN, E. H.
Effectiveness of an Urban Runoff Detention Pond-Wetlands System,
W89-00487 5G

MARTIN, F. D.
Effects of Cadmium on Early Developmental Stages of the Sheepshead Minnow (Cyprinodon Variegatus),
W89-01091 5C

MARTIN, J. H. A.
Clyde Sea Hydrography,
W89-00802 2L

Hydrography and Plankton of the Moray Firth,
W89-00778 2L

MARTIN, J. R.
Water Quality Management: A Regional Perspective-The Severn-Trent Area,
W89-00951 5G

MARTIN, L.
Size Structure of Planktonic Crustaceans in a Dimictic Lake on the Canadian Shield (Structure en Taille des Crustaces Planctoniques d'un Lac Dimictique du Bouclier Canadien),
W89-01231 2H

MARTIN, W. E.
Do Water Market Prices Appropriately Measure Water Values,
W89-00837 6D

Management of a Tributary Aquifer,
W89-00978 4B

MARTINELLI, L. A.
Contribution of Spartina alterniflora to the Pedra de Guaratiba (RJ) Salt Marsh Sediment Using Carbon-13 as a Tracer (Contribuicao de Materia Organica de Spartina alterniflora Para o Sedimento do Alagado de Pedra de Guaratiba (RJ): Uso de C13 como Tracador),
W89-00010 2L

MARTINEZ, J.
Characteristics of Soil after Pollution with Waste Waters from Olive Oil Extraction Plants,
W89-00602 5C

MARTINSEN, K.
Distribution of Chlorinated Organic Substances from Pulp Mills,
W89-00359 5B

Methods for Determination of Sum Parameters and Characterization of Organochlorine Compounds in Spent Bleach Liquors from Pulp Mills and Water, Sediment and Biological Samples from Receiving Waters,
W89-00358 5A

MASON, C. F.
Survey of Mercury, Lead and Cadmium in Muscle of British Freshwater Fish,
W89-00587 5B

MATAVULJ, M.
Microbiological Examination of the Carska Bara Swamp Water,
W89-00146 2H

MATHIS, B. J.
Macroinvertebrate Populations in a Thermally Impacted Reservoir,
W89-00397 5C

MATSUMOTO, M.
Studies on Formations and Changes of Micro-Stratification in Blackish Water Lake Shinji, (in Japanese),
W89-00772 2H

MATSUNAGA, K.
Distribution of Cadmium in Lake Tohya,
W89-00774 2H

MATTHEWS, R. A.
Fog Drip as a Source of Groundwater Recharge in Northern Kenya,
W89-00984 2F

MATUSZEK, J. E.
Application of Ecological Modelling: Impact of Thermal Effluent on a Smallmouth Bass Population,
W89-00317 5C

MAU, S. T.
Earthquake Response of Submerged Circular Arch,
W89-00306 8A

MAUGHAN, O. E.
Habitat Use of Two Darter Species in Glover River, Oklahoma,
W89-00396 2H

Relations Between Habitat Variables and Channel Catfish Populations in Prairie Streams,
W89-00325 2H

MAURICIO, J.
Heavy Metal Removal by Different Water Treatment Plants, in Rio de Janeiro State, Brazil,
W89-00647 5F

MAYER, F. L.
Waste Transformer Oil and PCB Toxicity to Rainbow Trout,
W89-00328 5C

MAYER, J.
Radioactivity of the Czechoslovakian Reach of the Danube River (Die Radioaktivitat im tschechoslowakischen Donauabschnitt),
W89-00171 5B

MAYER, K. S.
Waste Transformer Oil and PCB Toxicity to Rainbow Trout,
W89-00328 5C

MAYFIELD, C. I.
Microcomputer-Based Measurement of Algal Fluorescence as a Potential Indicator of Environmental Contamination,
W89-01157 5A

MCARDLE, E.
Pioneer Colonization and Interaction of Photosynthetic and Heterotrophic Microorganisms on an Artificial Substrate of Polyurethane Foam in E. J. Beck Lake, Illinois,
W89-00398 2H

MCCARTHY, T. S.
Roles of Sedimentation and Plant Growth in Changing Flow Patterns in the Okavango Delta, Botswana,
W89-00457 2J

MCCARTNEY, D. A.
Effects of Simulated Acidic Precipitation on Plant-Insect Interactions in Agricultural Systems: Corn and Black Cutworm Larvae,
W89-01160 5C

MCCARTY, L. S.
Volume Fraction Correlation for Narcosis in Aquatic Organisms: The Key Role of Partitioning,
W89-01096 5C

MCCOLL, J. G.
Hydrogen Ion Concentration and Alkalinity of Reservoir Water in the Sierra Nevada, California, and Correlations with Air Pollutants,
W89-01165 5B

MCCOMB, A. J.
Loss of Seagrass in Cockburn Sound, Western Australia: II. Possible Causes of Seagrass Decline,
W89-00116 5C

Nutrient Levels and the Development of Diatom and Blue-Green Blooms in a Shallow Australian Estuary,
W89-00211 2H

MCCONNELL, C. L.
General Correction for Spontaneous Potential Well Logs in Fresh Water,
W89-01195 7B

MCCORMICK, M. J.
Intercomparison of Four Mixed Layer Models in a Shallow Inland Sea,
W89-00831 2H

MCCREARY, N. J.
Effects of Fish Nests on Pattern and Zonation of Submersed Macrophytes in a Softwater Lake,
W89-00092 2H

MCCREARY, S.
Prospects for Transfer of the California Coastal Conservancy Model for Habitat Restoration to Other Coastal States,
W89-01070 6E

MCCUEN, R. H.
Multicriterion Stormwater Management Methods,
W89-00302 4A

MCELROY, A. E.
Biogeochemistry of Benz(a)anthracene at the Sediment-Water Interface,
W89-00612 5B

MCINTIRE, C. D.
Effects of Sediment Properties on Benthic Primary Production in the Columbia River Estuary,
W89-00115 2L

MCINTIRE, P. E.
Interactions Between Groundwater Seepage and Sediment Porewater Sulphate Concentration Profiles in Lake Anna, Virginia.
W89-00910 5B

MCINTYRE, A. D.
Sea and Fresh Waters,
W89-00797 2L

MCKAY, D. W.
Biology and Management of Herring and Other Pelagic Fish Stocks in the Firth of Clyde,
W89-00825 2L

MCKAY, G.
Multi-Component Sorption Isotherms of Basic Dyes onto Peat,
W89-00083 5D

MCKEAN, L.
Recreation Resource Allocation Model for Public Drinking Reservoirs,
W89-00921 6D

MCKEE, K. L.
Spartina alterniflora Die-Back in Louisiana: Time-Course Investigation of Soil Waterlogging Effects,
W89-00286 2H

MCKINLEY, V. L.
Microbial Biomass, Activity, and Community Structure of Water and Particulates Retrieved by Backflow from a Waterflood Injection Well,
W89-00334 5B

MCLAUGHLIN, D.
Distributed Parameter Approach for Evaluating the Accuracy of Groundwater Model Predictions: 1. Theory,
W89-00711 2F

Distributed Parameter Approach for Evaluating the Accuracy of Groundwater Model Predictions: 2. Application to Groundwater Flow,
W89-00712 2F

MCLEAN, R. O.
Epilithic Diatoms of the Clyde Estuary,
W89-00808 2L

MCLEOD, A. I.
Data Analysis of Water Quality Time Series in Lake Erie,
W89-00866 7C

MCLOUGHLIN, P. F. M.
O and M Spending Levels in Third World Irrigation Systems: Exploring Economic Alternatives,
W89-00874 3F

MCMANUS, G. B.
Clearance of Bacteria-Sized Particles by Natural Populations of Nanoplankton in the Chesapeake Bay Outflow Plume,
W89-01032 2L

MCQUAID, C. D.
Physical and Chemical Characteristics of the Waters of the Bot River Estuary, South Africa,
W89-00655 2L

Primary Productivity of the Bot River Estuary, South Africa,
W89-00656 2L

MCVEETY, B. D.
Atmospheric Deposition of Polycyclic Aromatic Hydrocarbons to Water Surfaces: A Mass Balance Approach,
W89-01257 5B

MEADOWS, G. A.
Intercomparison of Four Mixed Layer Models in a Shallow Inland Sea,
W89-00831 2H

MEADOWS, P. S.
Bioturbation, Microbial Activity and Sediment Properties in an Estuarine Ecosystem,
W89-00806 2L

MEDVEDEV, L. I.
Improvement of the Electrical Equipment and Control Systems to the Lock Mechanisms of the Moscow Canal,
W89-00052 8C

MEDVEDEV, V. S.
Set of Documents for Overhauling RO400-960-11 Turbines of the Inguri Hydroelectric Station,
W89-00060 8C

MEE, L. D.
Effect of Mangrove Humic-Like Substances on Biodegradation Rate of Detritus,
W89-00476 2L

MELACK, J. M.
Nitrate and Ammonium Uptake by Plankton in an Amazon River Floodplain Lake,
W89-00229 2H

Spatial and Temporal Distribution Patterns of Three Trophic Levels in a Saline Lake,
W89-00219 2H

MELCER, H.
Removal of Pentachlorophenol in Municipal Activated Sludge Systems,
W89-00509 5D

MELDRUM, D. T.
Clyde Sea Hydrography,
W89-00802 2L

MELIERES, M. A.
Chernobyl 134Cs, 137Cs, and 210Pb in High Mountain Lake Sediment: Measurements and Modeling of Mixing Process,
W89-00271 5B

MENDELSSOHN, I. A.
Spartina alterniflora Die-Back in Louisiana: Time-Course Investigation of Soil Waterlogging Effects,
W89-00286 2H

MENGOLI, M.
Sediment-Water Core Sampler for Coastal Pollution Studies,
W89-00641 5A

MERCER, J.
Coping with Groundwater Contamination,
W89-01135 5G

MERCER, J. W.
Groundwater Flow and Transport Modeling,
W89-01025 2F

MERKEL, B.
Hydrogeological and Hydrogeochemical studies of the Unsaturated Flow in a Gravel Aquifer: Part II. Results of Long Term Soil-hydrological Measurements (Hydrogeologische und Hydrochemische Untersuchungen in der Ungesaettigten Zone eines Kiesgrundwasserleiters: Teil II. Ergebnisse Langjaehriger Bodenhydrologischer Messungen),
W89-00503 2F

MERTZ, G.
Satellite Observations of Tidal Upwelling and Mixing in the St. Lawrence Estuary,
W89-00834 2L

MERZ, W.
Application of Headspace Gas Chromatography to the Monitoring of Organic Substances in Industrial Effluent,
W89-00572 5A

MESZAROS, M.
Tisza Water, as Irrigation Water, Polluted with Various Compounds,
W89-00145 3C

METCALF, T. G.
Polyethylene Glycol Precipitation for Recovery of Pathogenic Viruses, Including Hepatitis A Virus and Human Rotavirus, from Oyster, Water, and Sediment Samples,
W89-00730 5A

METCALFE, N. B.
Recent Changes in Numbers of Waders on the Clyde Estuary, and Their Significance for Conservation,
W89-00810 5C

METEYER, M. J.
Effects of Cadmium on Early Developmental Stages of the Sheepshead Minnow (Cyprinodon Variegatus),
W89-01091 5C

METZGER, R.
Water Supply Yields Power,
W89-01254 8C

MEULENBERGHS, F.
Repercussions of a CO2 Doubling on the Water Cycle and on the Water Balance - A Case Study for Belgium,
W89-00355 2A

MEYER, J. S.
Leaching of Retorted Oil Shale: Assessing the Toxicity to Colorado Squawfish, Fathead Minnows, and Two Food-Chain Organisms,
W89-00329 5C

MEYER, P. D.
Method for Locating Wells in a Groundwater Monitoring Network Under Conditions of Uncertainty,
W89-00971 7A

MEYERS, G.
Interannual Variability in Climate and Fisheries in Tasmania,
W89-00847 2A

MEYN, E. L.
Acute Toxicity of Thiocyanate to Trout,
W89-00330 5C

MIDDLEBROOKS, E. J.
Review of Rock Filters for the Upgrade of Lagoon Effluents,
W89-01235 5D

MIDDLETON, P.
Comparisons of RADM and Oscar Precipitation Chemistry Data,
W89-00433 5B

MIDGLEY, D. C.
National Water Management in the Republic of South Africa: Towards a Consultative Partnership with Diverse Users in a Semi-Arid Country,
W89-01029 6D

MIDGLEY, P.
River Regulation by Seasonal Groundwater Abstraction: The Case of the River Itchen,
W89-00956 4B

MIKHAILOV, L. P.
Preservation of Natural Fish Reproduction during Hydrotechnical Construction on Rivers,
W89-00069 8I

MIKHAILOVSKII, E. L.
Automation of Conveyor Transport at the Construction Site of Earth Dams,
W89-01173 8H

MIKHEEV, I. I.
Optimization of the Mud Intakes of Dredges with Submersible Pumps,
W89-00044 8C

MIKHNEVICH, E. I.
Calculation of the Suspended Load in Rivers and Canals,
W89-00552 7B

Stability of Sand Slopes in the Groundwater Discharge Zones,
W89-01174 8D

MIKLOSOVICOVA, L.
Bacterial Degradation of Crude Oil Water Pollutants in Danube Water (Die bakterielle Degradation von Erdolkohlenwasserstoffen im Donauwasser),
W89-00168 5B

MILLARD, S. P.
Tau-Like Test for Trend in the Presence of Multiple Censoring Points,
W89-00865 7C

MILLER, A. H.
Assessing Networked Coastal Zone Management Programs,
W89-00290 6B

MILLER, B. S.
Phytoplankton Ecology of the Firth of Clyde Sea-Lochs Striven and Fyne,
W89-00813 2L

Trace Metals in the Common Mussel Mytilus edulis (L.) in the Clyde Estuary,
W89-00823 5B

MILLER, C.
Role of Economic Benefits Analysis in Funding Marine Combined Sewer Overflow Projects - Case Study of Boston Harbor,
W89-01132 6C

MILLER, C. E.
Catalyst for Regionalization of Rural Water Systems,
W89-00883 6E

MILLER, C. W.
Optimization Model for Screening Multipurpose Reservoir Systems,
W89-00703 6A

MILLER, G. E.
Richness of Aquatic Macrophyte Floras of Soft Water Lakes of Differing pH and Trace Metal Content in Ontario, Canada,
W89-00103 5C

MILLER, G. W.
Role of the States in Solving the Small System Dilemma,
W89-01111 6E

MILLER, R. V.
Conjugal Transfer of R68.45 and FP5 between Pseudomonas aeruginosa Strains in a Freshwater Environment,
W89-00728 5B

MILLER, W. P.
Effect of Sodium Nitrate and Gypsum on Infiltration and Erosion of a Highly Weathered Soil,
W89-00409 2G

MILLS, A. L.
Interactions Between Groundwater Seepage and Sediment Porewater Sulphate Concentration Profiles in Lake Anna, Virginia,
W89-00910 5B

MILNE, R.
Tidal Power Ruffles Feathers,
W89-00850 8A

MINGHOU, J.
Studies on Marine Humic Substances: III. The Distribution of Humic Substances in Seawater and Sediments in the Estuary of Changjiang River and East China Sea, (in Chinese),
W89-00541 2L

MIROCHNA, J.
Water Pollution Control in Dallas-Fort Worth,
W89-01233 5G

MISHRA, A.
Improving Canal Water Deliveries with Auxiliary Storage,
W89-00758 3B

MISRA, P. K.
Relative Roles of Emissions Changes and Meteorological Variability of Wet sulfur Deposition: A Trajectory Model Study,
W89-01259 5B

MITAMURA, O.
Utilization of Nitrogenous Nutrients by Natural Phytoplankton in Enriched Lake Waters,
W89-00773 2H

MITCHELL, G. C.
Feeding of a Freshwater Flagellate, Bodo saltans, on Diverse Bacteria,
W89-00381 2H

MIURA, K.
Mechanism of Inactivation of Tobacco Mosaic Virus with Ozone,
W89-01229 5F

MIYATA, H.
Monitoring of PCDDs in Osaka Bay Using Blue Mussel,
W89-00604 5B

MIYOSHI, T.
Adsorption of Indigo Carmine by Activated Carbon,
W89-00633 5D

MJELDE, J. W.
Implications of Public Ownership of Irrigation Canal Systems in the Texas Rice Belt: Impacts on Water Use and Water Price,
W89-00460 6E

MO, S. C.
Speciation Studies of Copper and Magnesium in Duckweed Extract Using Interfaced HPLC and Thermospray Neubulizer Flame AA,
W89-00886 5D

MOCZULSKA, A.
Sorption of Cations by Bottom Sediments of Szczytno Male and Letowo Lakes, with Cage Trout Culture,
W89-00239 2H

MOE, C. L.
Septic System Performance on a Coastal Barrier Island,
W89-01163 5D

MOERMOND, J. O.
Survey of the International Law of Rivers,
W89-00835 6E

MOGLEN, G. E.
Multicriterion Stormwater Management Methods,
W89-00302 4A

MOLNAR, A.
Interaction of Some Environmental Factors in the Danube Delta on the Delimitation of the Vital Space Occupied by the Reed, Mace Reed and Sedge Cenoses (Die Einwirkung einiger Umweltfaktoren des Donaudeltas auf die Abgrenzung des Lebensraumes von Schilf-, Rohrkolben- und Seggengesellschaften),
W89-00163 2H

MOLZ, F. J.
Numerical Transport Model for Oxygen- and Nitrate-Based Respiration Linked to Substrate and Nutrient Availability in Porous Media,
W89-01251 5D

MONAGHAN, P.
Population Dynamics of Seabirds in the Firth of Clyde,
W89-00822 2L

MONTECINO, V.
Short-term Dynamics of a Melosira Population in the Plankton of an Impoundment in Central Chile,
W89-00214 2H

MONTEITH, J. L.
Does Transpiration Limit the Growth of Vegetation or Vice Versa,
W89-01013 2I

MONTGOMERY, H. A. C.
Role of Sewage Effluent in the Accumulation of Macroalgal Mats on Intertidal Mudflats in Two Basins in Southern England,
W89-00159 5C

MOORE, B. E.
Microbial Characterization of Municipal Wastewater at a Spray Irrigation Site: the Lubbock Infection Surveillance Study,
W89-01124 7B

MOORE, L.
Loss of Seagrass in Cockburn Sound, Western Australia: II. Possible Causes of Seagrass Decline,
W89-00116 5C

MOORE, P. G.
Seaweed-Associated Animal Communities in the Firth of Clyde, with Special Reference to the Population Biology of the Amphipod Hyale nilssoni (Rathke),
W89-00816 2L

MORCRETTE, J. J.
Comparison of Model-Generated and Satellite-derived Cloud Cover and Radiation Budget,
W89-01262 2A

MOREL, J.-L.
Novel Approach for Modifying Microporous Filters for Virus Concentration from Water,
W89-00332 5A

MORENO, E.
Characteristics of Soil after Pollution with Waste Waters from Olive Oil Extraction Plants,
W89-00602 5C

MORGAN, M. D.
Stream Chemistry in the New Jersey Pinelands: The Influence of Precipitation and Watershed Disturbance,
W89-00716 5B

MORIN, G.
Approximate Confidence Intervals for Verification Criteria of the WMO Intercomparison of Snowmelt Runoff Models,
W89-01143 2E

MOROZOV, A. S.
Determination of the Mechanical Characteristics of Rocks by the Method of Volume Confinement of Deformations,
W89-00548 8E

MORRIS, A. W.
Nitrite and Ammonia in the Tamar Estuary,
W89-00154 5B

MORRIS, E. B.
Dynamics of Iron and Manganese in the Surface Sediments of a Seasonally Anoxic Lake,
W89-00188 2H

MORRISON, G. M. P.
Size Distribution and Copper Association of Dissolved Organic Material in Urban Runoff,
W89-00628 5B

MORRISON, J. A.
Biology and Management of Herring and Other Pelagic Fish Stocks in the Firth of Clyde,
W89-00825 2L

MORRISSEY, K. M.
Nitrate and Ammonium Uptake by Plankton in an Amazon River Floodplain Lake,
W89-00229 2H

Regeneration and Uptake of Ammonium by Plankton in an Amazon Floodplain Lake,
W89-00230 2H

MOSEHOLM, L.
Changes in Rainwater Acidity Associated with Closure of a Copper Smelter,
W89-00272 5B

MOSELLO, R.
Role of External Ammonium Inputs in Freshwater Acidification,
W89-00024 5B

MOSIYASH, S. S.
State of the Ichthyofauna in Istrinsk Reservoir Since Its Conversion into a Recreational Water,
W89-01191 2H

MOSTAGHIMI, S.
Evaluation of Vegetation Filter Strips as a Best Management Practice for Feed Lots,
W89-01125 5G

MOSTKOV, V. M.
Improvement of the Layouts and Design of Underground Hydraulic Structures,
W89-01172 8E

MOYLE, P. B.
Influence of Temperature on Microhabitat Choice by Fishes in a California Stream,
W89-00027 2H

Microhabitat Use by an Assemblage of California Stream Fishes: Developing Criteria for Instream Flow Determinations,
W89-00319 6D

MOZETO, A. A.
Contribution of Spartina alterniflora to the Pedra de Guaratiba (RJ) Salt Marsh Sediment Using Carbon-13 as a Tracer (Contribuicao de Materia Organica de Spartina alterniflora Para o Sedimento do Alagado de Pedra de Guaratiba (RJ): Uso de C13 como Tracador),
W89-00010 2L

MUEHLENHARDT-SIEGEL, U.
Soft Bottom Fauna Near the River Elbe Estuary under the Influence of Sewage Sludge. I. Seasonal Variation of Species Number, Abundance and Biomass in Relation to Sediment Structure (Die Weichbodenfauna vor der Elbemuendung unter dem Einfluss der Klaerschlammverklappung. I. Die Saisonale Veraenderung von Arten- und Individuenzahl sowie Biomasse unter Beruecksichtigung der Sedimentstrucktur),
W89-00316 5C

MULLER, D.
Impact of Impounding on the Oxygen Balance of the Danube from Kelheim to Jochenstein Microbiological-Biochemical Investigations and Water Quality Model Calculations (Zum Einfluss der Strauregulierung auf den Sauerstoffhaushalt der Donaustrecke Kelheim-Jochenstein: Mikrobiologisch-biochemische Untersuchungen und Gutemodellrechnungen),
W89-00173 6G

Reliability of Chemical Analyses of Water Samples: The Experience of the UMTRA Project,
W89-00941 5A

MULLER, J.
Oxygen Budget of a River in Submerged Macrophytes (River Zschopau in the South of the GDR),
W89-00137 2H

MULLER, M. S.
Simple and Efficient New Design of the Submersible Stirrer for the YSI Dissolved Oxygen Meter,
W89-00936 7B

MUNAWAR, M.
Microcomputer-Based Measurement of Algal Fluorescence as a Potential Indicator of Environmental Contamination,
W89-01157 5A

MURAKAMI, M.
Dynamical Structure of Vertically Two-Dimensional Estuary in Steady State,
W89-00680 2L

MURAV'EV, O. A.
Reconstruction of the Surge Tank of the Sengilei Hydroelectric Station,
W89-00546 8C

MURISON, D. J.
Benthic Fauna of Sandy Bays, with Particular Reference to Irvine Bay,
W89-00819 5C

MURPHY, E. F.
Recurring State Judicial Task of Choosing Rules for Groundwater Law: How Occult Still,
W89-01268 6E

MUSTAFA, M. A.
Horizontal Infiltration of Water in Soil Columns as Affected by a Gel-Forming Conditioner,
W89-00741 2G

MUTAGUCHI, S.
Studies on Formations and Changes of Micro-Stratification in Blackish Water Lake Shinji, (in Japanese),
W89-00772 2H

MYERS, D. A.
Sensitivity of Four Monitoring Well Sampling Systems to Low Concentration of Three Volatile Organics,
W89-00944 5A

NADEAU, T.
Copper, Nickel, and Chrome Recovery in a Jobshop to Eliminate Waste Treatment and Sludge Disposal,
W89-00993 5D

NAGABHUSHANAM, P.
Validity of the Environmental Chloride Method for Recharge Evaluation of Coastal Aquifers, India.
W89-00356 7B

NAGAO, M.
River Improvement Planning for Flood Protection in the Kiso River Basin until the Meiji Era, (in Japanese),
W89-00204 4A

NAKAJIMA, K.
Phosphorus Removal by Crystallization Using a Granular Activated Magnesia Clinker,
W89-01126 5D

NAKATANI, R. E.
Homing of Adult Chinook Salmon after Brief Exposure to Whole and Dispersed Crude Oil,
W89-00375 5C

NANDAN, S. N.
Species Diversity of Algal Flora in Vishwamitri River, Baroda (India),
W89-00234 2H

NANEY, J. W.
Vertical Variability of Soil Properties in a Small Watershed,
W89-00354 2G

NANSHAN, D.
Primary Studies on Population Dynamics of 3 Species of Cladocera (Waterflea) in Dianshan Lake, (in Chinese),
W89-00198 2H

NASH, R. D. M.
Effects of Disturbance and Severe Seasonal Fluctuations in Environmental Conditions on North Temperate Shallow-water Fish Assemblages,
W89-00282 2L

NATH, K.
Impact of Manganese Intoxication on the Blood Pyruvic Acid of a Freshwater Tropical Perch Colisa fasciatus,
W89-00263 5A

NAYLOR, L. M.
Assessing Effects of Soil Pollution Control Residuals on Soil Chemistry Properties,
W89-01140 5E

NEAL, C.
Modelling the Effects of Acid Deposition: Estimation of Long-Term Water Quality Responses in Forested Catchments in Finland,
W89-00894 5B

NEAL, M. W.
Comparison of Drinking Water Mutagenicity with Leaching of Polycyclic Aromatic Hydrocarbons from Water Distribution Pipes,
W89-00619 5C

NEALSON, K. H.
Manganese Oxidation in pH and O2 Microenvironments Produced by Phytoplankton,
W89-01045 2K

NEARY, B. P.
Effects of Sulphur Deposition on Lake-Water Chemistry in Ontario, Canada,
W89-00846 5B

NECHESKA, I. F.
Reconstruction of the Surge Tank of the Sengilei Hydroelectric Station,
W89-00546 8C

NECKLES, H. A.
Model of Zostera marina L. Photosynthesis and Growth: Simulated Effects of Selected Physical-Chemical Variables and Biological Interactions,
W89-00130 2L

NEEMAN, B. U.
Vertically Integrated Snow/Ice Model over Land/Sea for Climate Models: 1. Development,
W89-01260 2C

Vertically Integrated Snow/Ice Model over Land/Sea for Climate Models: 2. Impact on Orbital Change Experiments,
W89-01261 2C

NEILSON, A. H.
Environmental Fate of Chloroguaiacols and Chlorocatechols,
W89-00369 5B

NEMCHINOV, V. V.
Seismic Stress State of Underground Structures with Consideration of the Effect of the Free Surface,
W89-00035 8E

Size of the Concrete Part of a Combined Apron below Low-head Outlet Works,
W89-01175 8B

NESTOR, I.
Viral Pollution of Surface Waters by Domestic Waste Water Discharge (Die Viral-Verunreinigung der Oberflachengewasser durch Ableiten der Haushaltsabwasser),
W89-00170 5B

NEU, H. J.
Application of Headspace Gas Chromatography to the Monitoring of Organic Substances in Industrial Effluent,
W89-00572 5A

NEUBAUER, J.
Determination of Nitrate at the Ng/g Level in Antarctic Snow Samples with Ion Chromatography and Isotope Dilution Mass Spectrometry,
W89-00269 5A

Nitrate Trace Determinations in Snow and Firn Core Samples of Ice Shelves at the Weddell Sea, Antarctica,
W89-01258 5B

NEUMAN, E.
Effects of a Bleached Pulp Mill Effluent on Growth and Gonad Function in Baltic Coastal Fish,
W89-00367 5C

Effects of Pulp Mill Effluent on a Baltic Coastal Fish Community,
W89-00366 5C

NEVES, E. A.
Evaluation of the Sulfur(IV) Catalyzed Autoxidation of Cobalt(II) in an Azide Containing Medium as a Means for the Determination of Sulfite in Precipitation,
W89-00736 5A

NEVES, R. J.
Habitat Suitability and Fish Production: A Model Evaluation for Rock Bass in Two Virginia Streams,
W89-00294 2H

NEVISSI, A. E.
Homing of Adult Chinook Salmon after Brief Exposure to Whole and Dispersed Crude Oil,
W89-00375 5C

NEWSTED, J. L.
Comparison of Three Sediment Bioassay Methods Using Detroit River Sediments,
W89-01097 5A

NG, P. S.
Biochemical Models for the Hypolimnetic Oxygen Depletion in Lakes Impacted by Wastewater Discharges: 1. Alternative models,
W89-00186 5C

Biochemical Models for the Hypolimnetic Oxygen Depletion in Lakes Impacted by Wastewater Discharges: 2. Phytoplankton Biomass Model,
W89-00189 5C

NI, V. E.
Reliability and Safety Inspection of Hydraulic Structures of the Moscow Canal,
W89-00051 8A

NICHOLAS, W. D.
Method to Assess Periodic Responses of Aquatic Microecosystems to Photosynthetic Inhibition,
W89-00562 7B

NICHOLLS, N.
El Nino-Southern Oscillation and Rainfall Variability,
W89-00276 2B

NICOL, J. P.
Activated Sludge Systems with Biomass Particle Support Structures,
W89-01256 5D

NIELSEN, K.
High Rates of Production and Mortality of Submerged Sparganium emersum Rehman during Its Short Growth Season in a Eutrophic Danish Stream,
W89-00099 2H

NIELSEN, L. A.
Fish Production in the Kanawha River and its Relation To Barge Traffic,
W89-00249 6G

Impacts of Navigation on Riverine Fish Production in the United States,
W89-00248 6G

NIELSEN, L. W.
High Rates of Production and Mortality of Submerged Sparganium emersum Rehman during Its Short Growth Season in a Eutrophic Danish Stream,
W89-00099 2H

NIELSEN, P. H.
Effect of Sulfate and Organic Matter on The Hydrogen Sulfide Formation in Biofilms of Filled Sanitary Sewers,
W89-00510 5D

NIEMCZYNOWICZ, J.
Spatial and Temporal Scales in Rainfall Analysis Some Aspects and Future Perspectives,
W89-01021 2B

NIEUWENHUIZE, J.
Partitioning of Organochlorines Between Water, Particulate Matter and Some Organisms in Estuarine and Marine Systems of the Netherlands,
W89-00672 5B

NINOMIYA, K.
Evolution and Fine Structure of a Long-Lived Meso-alpha-Scale Convective System in a Baiu Frontal Zone. Part II: Meso-gamma-Scale Characteristics of Precipitation,
W89-00416 2B

NIVAL, P.
Pelagic Ecosystem Model Simulating Production and Sedimentation of Biogenic Particles: Role of Salps and Copepods,
W89-01041 2L

NIX, S. J.
Alternative Strategies for Stormwater Detention,
W89-00875 4A

NIXON, J. F.
Subsoil Investigation of Ice Lensing at the Calgary, Canada, Frost Heave Test Facility,
W89-00389 2C

NKEDI-KIZZA, P.
Sorption Nonequilibrium During Solute Transport,
W89-00988 5B

NODVIN, S. C.
Soil Processes and Sulfate Loss at the Hubbard Brook Experimental Forest,
W89-00206 5B

NOFZIGER, D. L.
Effect of Assumed Unit Gradient During Drainage on the Determination of Unsaturated Hydraulic Conductivity and Infiltration Parameters,
W89-00407 2G

NOLL, K. E.
Gravimetric Measurement of Adsorption Parameters in Water Systems with a Quartz Spring Balance,
W89-01216 5A

NOLTING, R. F.
River Ems: Processes Affecting the Behaviour of Metals and Organochlorines during Estuarine Mixing,
W89-00149 5B

NOOT, D. K.
Review of the Use of XAD Resins to Concentrate Organic Compounds in Water,
W89-01215 5A

NORDQVIST, K. R.
Effects of Cyanide and Polyphosphates on Adsorption of Metals from Simulated and Real Mixed-Metal Plating Wastes,
W89-01219 5D

NORSTROM, R. J.
Organochlorines and Eggshell Thinning in Northern Gannets (Sula bassanus) from Eastern Canada, 1968-1984,
W89-01054 5C

NORTON, T. A.
Ecology of Macroalgae in the Firth of Clyde,
W89-00815 2L

NOSEK, A.
Influence of Dusts from Chosen Industrial Plants on Particular Links of Forest Ecosystem of the Niepolomice Forest,
W89-00081 5C

NOSOVA, O. N.
Some Results of Investigating the State of the Powerhouse of the Plyavinyas Hydroelectric Station,
W89-01180 8D

NOVOTNY, V.
Diffuse (Nonpoint) Pollution - A Political, Institutional, and Fiscal Problem,
W89-01134 5G

NOYOLA, A.
Selected Dyes for Residence Time Distribution Evaluation in Bioreactors,
W89-00404 5D

NUNEZ, M.
Interannual Variability in Climate and Fisheries in Tasmania,
W89-00847 2A

NYER, E. K.
Treatment of Herbicides in Ground Water,
W89-00938 5F

O'BRIEN, J. S.
Laboratory Analysis of Mudflow Properties,
W89-00899 2J

O'BRIEN, P.
Effects of Discontinuing Disinfection on a Receiving Water,
W89-00515 5D

O'LOUGHLIN, J. F.
Changes in Rainwater Acidity Associated with Closure of a Copper Smelter,
W89-00272 5B

O'MORCHOE, S. B.
Conjugal Transfer of R68.45 and FP5 between Pseudomonas aeruginosa Strains in a Freshwater Environment,
W89-00728 5B

O'NEILL, I. C.
Use of Map Analysis to Elucidate Flooding in an Australian Riparian River Red Gum Forest,
W89-00722 2E

OBEYSEKERA, J. T. B.
Multivariate Periodic ARMA (1,1) Processes,
W89-00967 7B

ODDE, R. A.
Funding Reserve Capacity in Wastewater Systems,
W89-00506 5D

OGAKI, J.
Monitoring of PCDDs in Osaka Bay Using Blue Mussel,
W89-00604 5B

OGORODNIKOV, S. P.
Optimization of the Mud Intakes of Dredges with Submersible Pumps,
W89-00044 8C

OGUNSEITAN, O.
Conjugal Transfer of R68.45 and FP5 between Pseudomonas aeruginosa Strains in a Freshwater Environment,
W89-00728 5B

OHLINE, B. A.
Clean Air Act-Transboundary Acid Rain Pollution Abatement-Administrative Discretion Citizen Suit,
W89-00839 5G

OHRING, G.
Vertically Integrated Snow/Ice Model over Land/Sea for Climate Models: 1. Development,
W89-01260 2C

Vertically Integrated Snow/Ice Model over Land/Sea for Climate Models: 2. Impact on Orbital Change Experiments,
W89-01261 2C

OHTA, K.
Experiments on Seawater Desalination by Membrane Distillation,
W89-01063 3A

OIKARI, A.
Acclimatization of Roach, Rutilus rutilus (L.), to Toxic Components of Kraft Pulp Mill Effluents,
W89-00087 5C

OKLA, L.
Microbial Degradation of Xenobiotic, Aromatic Pollutants in Humic Water,
W89-00344 5B

OLESZKIEWICZ, J. A.
Effects of Biofilter Media on the Performance of Anaerobic Hybrid Reactors,
W89-00626 5D

OLSEN, Y.
Limnocorral Experiments in a Eutrophic Lake - Effects of Fish on the Planktonic and Chemical Conditions,
W89-00253 2H

ONDOK, J. P.
Evapotranspiration of a Willow Carr in Summer,
W89-00125 2D

Patterns of Temperature and Humidity in Wetland Biotopes,
W89-00124 2H

ONGLEY, E. D.
Is Water a Relevant Sampling Medium for Toxic Chemicals: An Alternative Environmental Sensing Strategy,
W89-01162 5A

OPUSZYNSKI, K.
Feedback Dependence Between the Eutrophication Process and Changes in the Fish Community: The Theory of Ichthyoeutrophication (Sprzezenie zwrothe miedzy procesum eutrofizacji a zmianami zespolu ryb. Tesri ichtioeutrofizacji),
W89-00031 5C

ORCUTT, A. M.
Distribution of Arsenic in the Sediments and Biota of Hilo Bay, Hawaii,
W89-00677 5B

ORIS, K. T.
Photo-induced Toxicity of Polycyclic Aromatic Hydrocarbons to Larvae of the Fathead Minnow (Pimephales promelas),
W89-00595 5C

ORTH, D. J.
Application and Testing of an Index of Biotic Integrity in Small, Coolwater Streams,
W89-00323 2H

Effects of Temperature and Streamflow on Time and Duration of Spawning by Smallmouth Bass,
W89-00373 2H

Fish Production in the Kanawha River and its Relation To Barge Traffic,
W89-00249 6G

Impacts of Navigation on Riverine Fish Production in the United States,
W89-00248 6G

ORVICHIAN, S.
Improving Water Supply in Thailand,
W89-00422 5F

OSBORN, D. W.
Sewage Purification in South Africa - Past and Present,
W89-00933 5D

OSBORNE, J.
Emissions of Chlorinated Organics from a Municipal Sewage Sludge Burning Incinerator,
W89-00607 5B

OSIPOV, A. D.
Technology of Casting Precast Pipeline Elements of the Kaisiadory's Pumped-Storage Station,
W89-00045 8F

OSMAN, M. M.
Environmental Conditions in Abu Kir Bay, East of Alexandria: I. Physico-chemical Characteristics and Water Circulation,
W89-00565 5B

Environmental Conditions in Abu Kir Bay, East of Alexandria: II. Plankton Distribution, Downstream from Land-Based Effluents,
W89-00578 5C

OTMAKHOV, V. N.
Manufacture of Polyethylene Seals for High-head Gates of Hydraulic Structures,
W89-00043 8G

OTTOW, J. C. G.
Scanning Electron Microscopy of Bacteria and Diatoms Attached to a Submerged Macrophyte in an Increasingly Polluted Stream,
W89-00132 5C

OUZOUNIS, K.
Ecological Parameter of Surface Water in Northeastern Greece,
W89-00564 5B

OVENDEN, J. C.
Quantity of Stormwater Runoff from Ten Stretches of Road, a Car Park and Eight Roofs in Hertfordshire, England During 1983,
W89-00912 4C

OZHAN, E.
Flow Regimes and Dynamic Equilibrium of Morphological Changes at Koycegiz Lake Inlet, Turkey,
W89-00449 8B

OZVACIC, V.
Emissions of Chlorinated Organics from a Municipal Sewage Sludge Burning Incinerator,
W89-00607 5B

PAASIVIRTA, J.
Organochlorine Compounds in the Environment,
W89-00368 5C

PACE, M. L.
Bacterial Production in Fresh and Saltwater Ecosystems: A Cross-System Overview,
W89-01034 2H

PADISAK, J.
Role of Storms in the Summer Succession of the Phytoplankton Community in a Shallow Lake (Lake Balaton, Hungary),
W89-00232 2H

PADMANABHAN, G.
Maximum Entropy Spectral Analysis of Hydrologic Data,
W89-01248 2A

PAERL, H. W.
Modeling Blue-Green Algal Blooms in the Lower Neuse River,
W89-01225 5C

PAFFEN, B. G. P.
Effects of the Season and of Water Chemistry on the Decomposition of Nymphaea alba L.: Weight Loss and Pyrolysis Mass Spectrometry of the Particulate Matter,
W89-00096 2H

PAJAK, P.
Habitat Suitability and Fish Production: A Model Evaluation for Rock Bass in Two Virginia Streams,
W89-00294 2H

PALAUSCHEK, N.
Destruction of Polychlorinated Dibenzo-p-Dioxins and Dibenzofurans in Contaminated Water Samples Using Ozone,
W89-00606 5D

Determination of Substituted Aromatic Amines in Water and Sediment Samples,
W89-00738 5A

PALAWSKI, D.
Sensitivity of Young Striped Bass to Organic and Inorganic Contaminants in Fresh and Saline Waters,
W89-00320 5C

PALDOR, N.
Microscale Haline Convection - A Proposed Mechanism for Transport and Mixing at the Water Table Region,
W89-00718 2F

PALERMO, M. R.
Flocculent Settling above Zone Settling Interface,
W89-00484 5E

PALMER, R. E.
Comparative Sensitivities of Bluegill, Channel Catfish and Fathead Minnow to pH and Aluminum,
W89-01098 5C

PANASYUK, A. M.
Small Hydroelectric Stations and Prospects of Their Development,
W89-00059 8C

PANCZAKOWA, J.
Changes in Chlorophyll Contents of Swietokrzyskie Lake Phytoplankton, as Related to Qualitative and Quantitative Fluctuations of Phytoplankton Density and of the Physicochemical Conditions in this Lake in Summer 1979,
W89-00257 5C

Concentrations of Nitrogen and Phosphorus in Waters of Two Hypertrophic Lakes and Their Effect on the Quantity of Phytoplankton Biomass,
W89-00245 2H

Qualitative and Quantitative Changes in Phytoplankton on the Background of Physicochemical Changes in the Water of Swietokrzyskie Lake in the Years 1977-1979,
W89-00258 5C

PANDZIC, K.
Principal Component Analysis of Precipitation in the Adriatic-Pannonian Area of Yugoslavia,
W89-00472 2B

PANKOW, J. F.
Discrete Point Sampler for Ground Water Monitoring Wells,
W89-00947 7B

PANT, J. C.
Branchial and Renal Pathology in the Fish Exposed Chronically to Methoxy Ethyl Mercuric Chloride,
W89-01156 5C

PAPACHRISTOU, E.
Boron Levels in Some Ground Waters of Halkidiki (A Land at Northern Aegean Sea),
W89-00569 5B

PAPAKYRIAZIS, A.
Maximally Informative Environmental Control Policies for Natural Resource Systems with Probabilistic Constraints,
W89-00458 6A

PAPPAS, S.
Analysis of ppb Levels of Organics in Water by Means of Purge-and-Trap, Capillary Gas Chromatography and Selective Detectors,
W89-00288 5A

PAPROWICZ, J.
Application of Biologically Activated Sorptive Columns for Textile Waste Water Treatment,
W89-00632 5D

PAREDES, M. J.
Characteristics of Soil after Pollution with Waste Waters from Olive Oil Extraction Plants,
W89-00602 5C

PARICOS, P.
Stream Acidification Trends in the Welsh Uplands: A Modelling Study of the Llyn Brianne Catchments,
W89-01206 5C

PARKER, B. C.
Physiological Ecology of Bluegreen Algal Mats (Modern Stromatolites) in Antarctic Oasis Lakes,
W89-00185 2H

PARKER, G. A.
Determination of Fluoride Ion in Well Waters of Eastwood School District, Wood County, Ohio,
W89-00684 5A

PARLAND, W. K.
Tumor Frequencies and Contaminant Concentrations in Brown Bullheads from an Industrialized River and a Recreational Lake,
W89-00028 5C

PARLANGE, J.-Y.
Air and Water Flow: I. Horizontal Flow with an Arbitrary Flux Boundary Condition,
W89-00347 2G

Air and Water Flow: II. Gravitational Flow with an Arbitrary Flux Boundary Condition,
W89-00348 2G

Extension of the Fujita Solution to Air and Water Movement in Soils,
W89-00725 2G

Infiltration under Ponded Conditions: 2. Infiltration Equations Tested for Parameter Time-Dependence and Predictive Use,
W89-00740 2G

PARR, A. D.
Modified Fickian Model for Solute Uptake by Runoff,
W89-00486 5B

PARRISH, C. R.
Effects of Increasing Salinity on a Cyanobacteria Bloom in the Potomac River Estuary,
W89-00231 2H

PARRISH, R. S.
Estimate of the Variability in Biotransformation Kinetics of Xenobiotics in Natural Waters by Aufwuchs Communities,
W89-00559 5B

PATEL, R. J.
Species Diversity of Algal Flora in Vishwamitri River, Baroda (India),
W89-00234 2H

PATEREK, J. R.
Populations of Anaerobic Phototrophic Bacteria in a Spartina alterniflora Salt Marsh,
W89-00333 2L

PATIL, S. S.
Simultaneous Gas Chromatographic Determination of Nitrobenzene and 2,4-Dinitrophenol in Nitrobenzene Manufacturing Plant Wastewater,
W89-00479 5A

PATRIARCHE, G. J.
Determination of Cobalt Ions in Natural Waters Using Differential Pulse Adsorptive Stripping Voltammetry,
W89-00480 5A

PATTERSON, J. C.
Thermal Simulation of a Lake with Winter Ice Cover,
W89-01044 2H

PAUER, J. J.
Determination of Phosphate at Low Concentrations in Surface Waters by Flow-Injection Analysis,
W89-00931 5A

PAUL, J. H.
Mechanisms of DNA Utilization by Estuarine Microbial Populations,
W89-00340 2L

PAYMENT, P.
Wound Fiberglass Depth Filters as a Less Expensive Approach for the Concentration of Viruses from Water,
W89-00279 5A

PAYNE, A. G.
Nitrilotriacetic Acid (NTA) Environmental Monitoring Program in Indiana: 1979 to 1983,
W89-01089 5A

PAYNE, B. R.
Status of Isotope Hydrology Today,
W89-01018 2A

PAYNTER, M. J. B.
Populations of Anaerobic Phototrophic Bacteria in a Spartina alterniflora Salt Marsh,
W89-00333 2L

PEARSON, T. H.
Benthos of the Deeper Sediments of the Firth of Clyde, with Particular Reference to Organic Enrichment,
W89-00820 5C

PEASE, S. R.
Mesoscale Spiral Vortex Embedded within a Lake Michigan Snow Squall Band: High Resolution Satellite Observations and Numerical Model Simulations,
W89-00748 2B

PECHKURENKOV, V. L.
Possibility of Using Radioactively Polluted Waterbodies for Fish Culture,
W89-01193 3C

PELEG-OLEVSKY, E.
Association Between Seawater Pollution as Measured by Bacterial Indicators and Morbidity Among Bathers at Mediterranean Bathing Beaches of Israel,
W89-00579 5C

PENG, G. C.
Petaling Jaya Non-Revenue Water Control Project Selangor, Malaysia,
W89-00923 5F

PENNINO, J. D.
There's No Such Thing as a Representative Ground Water Sample,
W89-00937 5A

PEPOYAN, V. S.
Estimation of the Reliability of Earth Dams with Consideration of Seismic Loads,
W89-00557 8E

PEREIRA, W. E.
Creosote Compounds in Snails Obtained from Pensacola Bay, Florida, near an Onshore Hazardous-Waste Site,
W89-00611 5B

PERIN, G.
Comparison of Co-Digestion Performance of Two Differently Collected Organic Fractions of Municipal Solid Waste with Sewage Sludges,
W89-00643 5D

PERISSINOTTO, R.
Short-Term Variations in the Zooplankton Community Related to Water Exchange Processes in the Gullmar Fjord, Sweden,
W89-00228 2H

PERRY, J. A.
Diel and Seasonal Carbon Budgets in Two Cold Spring Ecosystems,
W89-00177 2H

Networking Urban Water Supplies in West Africa,
W89-00419 5F

PERRY, R.
Review of the Behaviour and Utilization of Polycarboxylic Acids as Detergent Builders,
W89-00620 5D

PERSSON, G.
Community Grazing and the Regulation of In Situ Clearance and Feeding Rates of Planktonic Crustaceans in Lakes in the Kuokkel Area, Northern Sweden,
W89-00181 2H

PESHKOV, S. P.
Possibility of Using Radioactively Polluted Waterbodies for Fish Culture,
W89-01193 3C

PETERS, N. E.
Short-Term Trends in Sulfate Deposition at Selected Bulk Precipitation Stations in New York,
W89-00432 5B

PETERS, R. W.
Evaluation of Chemical Oxidizers for Hydrogen Sulfide Control,
W89-01129 5D

PETERSON, J. H.
Financing Strategies for Small Systems,
W89-01113 5F

PETROVIC, G.
Some Hydrochemical, Hydrobiological, and Ichthyological Features of Yugoslav Part of the Danube Lasting for Several Years (Einige hydrochemische, hydrobiologische und ichthyologische Eigenschaften der jugoslawischen Donaustrecke in mehrjahrigem Zeitraum),
W89-00165 5C

PETROVIC, O.
Microbiological Examination of the Carska Bara Swamp Water,
W89-00146 2H

PETROZZI, S.
Operation of a Three-Phase Biofilm Fluidized Sand Bed Reactor for Aerobic Wastewater Treatment,
W89-00747 5D

PETTS, G.
Hydrological Changes and the River Regulation in the UK,
W89-00957 4A

PETTS, G. E.
Regulated Rivers in the United Kingdom,
W89-00948 4A

PEVIN, C. S.
Estimating Soil/Sediment Partition Coefficients for Organic Compounds by High Performance Reverse Phase Liquid Chromatography,
W89-01223 5B

PFEIFFER, W. C.
Heavy Metal Removal by Different Water Treatment Plants, in Rio de Janeiro State, Brazil,
W89-00647 5F

Mercury Inputs into the Amazon Region, Brazil,
W89-00637 5B

PHILIP, J. R.
Steady Unsaturated Seepage above a Sloping Impermeable Base,
W89-00726 2G

PHILLIPS, R. A.
Relationship Between Glacial Geology and Streamwater Chemistry in an Area Receiving Acid Deposition,
W89-01210 5B

PIBOULE, M.
Chernobyl 134Cs, 137Cs, and 210Pb in High Mountain Lake Sediment: Measurements and Modeling of Mixing Process,
W89-00271 5B

PICER, M.
Investigation of the Production of Lipophilic Volatile Organohalogen Materials during Laboratory Chlorination of some Ground Water Samples from Yugoslavia,
W89-00608 5F

PICER, N.
Investigation of the Production of Lipophilic Volatile Organohalogen Materials during Laboratory Chlorination of some Ground Water Samples from Yugoslavia,
W89-00608 5F

PICKEN, G. B.
Moray Firth Marine Fouling Communities,
W89-00781 2L

PICKERING, Q. H.
Evaluation and Comparison of Two Short-Term Fathead Minnow Tests for Estimating Chronic Toxicity,
W89-01224 5A

PICKERING, W. F.
Sediment Analysis: Lability of Selectively Extracted Fractions,
W89-00744 5A

PIECZYNSKA, E.
Sources and Fate of Detritus in the Shore Zone of Lakes,
W89-00121 2H

PIEHL, B. T.
Flow Capacity of Culverts on Oregon Coast Range Forest Roads,
W89-00878 8B

PIEKARCZYK, R.
Pioneer Colonization and Interaction of Photosynthetic and Heterotrophic Microorganisms on an Artificial Substrate of Polyurethane Foam in E. J. Beck Lake, Illinois,
W89-00398 2H

PIERCE, S. M.
Primary Productivity of the Bot River Estuary, South Africa,
W89-00656 2L

PIESCIKOWSKI, K.
Effect of Witobelskie and Lodzko-Dymaczewskie Lakes on Phytoplankton of Samica Steszewska River,
W89-00247 2H

PIETRUSZKA, R. D.
Predictability of Two Moisture Sources in the Namib Desert,
W89-00455 2B

PIKE, W. S.
54 Hours of Continuous Post-Frontal Precipitation North of the Alpine Mountain Barrier, 22-25 August 1975,
W89-00464 2B

PILGRIM, D. H.
Problems of Rainfall-Runoff Modelling in Arid and Semiarid Regions,
W89-01144 2E

PINEL-ALLOUL, B.
Size Structure of Planktonic Crustaceans in a Dimictic Lake on the Canadian Shield (Structure en Taille des Crustaces Planctoniques d'un Lac Dimictique du Bouclier Canadien),
W89-01231 2H

PINFOLD, J. V.
Fecal Coliform Fingertip Count: A Potential Method for Evaluating the Effectiveness of Low Cost Water Supply and Sanitation Initiatives,
W89-00379 5G

PINGLOT, J. F.
Chernobyl 134Cs, 137Cs, and 210Pb in High Mountain Lake Sediment: Measurements and Modeling of Mixing Process,
W89-00271 5B

PINTO-COELHO, R. M.
Seasonal and Short-Term Fluctuations in the Zooplankton Community of Paranoa Reservoir, Brasilia, Federal District, Brazil (Flutuacoes Sazonais e de Curta Duracao na Comunidade Zooplanktonica do Lago Paranoa, Brasilia-DF, Brasil),
W89-00006 2H

PIONKE, H. B.
Chemical-Hydrologic Interactions in the Near-Stream Zone,
W89-00717 2E

PIP, E.
Ecology of Freshwater Gastropods in the Central Canadian Region,
W89-01183 2H

PIRIE, J. M.
Monitoring the Moray Firth Environment,
W89-00787 5C

PISAREV, Y. V.
Effect of Runoff Variability on Deformation of Erodible Channels near Structures,
W89-00072 2J

PLATE, E. J.
Operational Models for Flood Calculations,
W89-01030 2A

PLINSKI, M.
Contemporary Changes in Coastal Biocenoses of the Gdansk Bay (South Baltic), A Review,
W89-00254 2L

PLOTNER, J.
Toxicity of an Anionic Detergent to the Spawn and Larvae of Anurans (Amphibia),
W89-00139 5C

PLUMB, O. A.
Dispersion in Heterogeneous Porous Media: 1. Local Volume Averaging and Large-Scale Averaging,
W89-00699 5B

Dispersion in Heterogeneous Porous Media: 2. Predictions for Stratified and Two-Dimensional Spatially Periodic Systems,
W89-00700 5B

POCHOP, L.
Analyses of Equations for Free Water Evaporation Estimates,
W89-00705 2D

PODOLL, R. T.
Sorption of Cationic Oligomers on Sediments,
W89-01094 5B

POKROVSKAYA, G. L.
Possibility of Using Radioactively Polluted Waterbodies for Fish Culture,
W89-01193 3C

POLLMAN, C. D.
Alkalinity Regulation in Softwater Florida Lakes,
W89-00714 2H

POLPRASERT, C.
Ammonia Nitrogen Removal in Attached-Growth Ponds,
W89-00489 5D

PONOMAREV, I. F.
Prospects of Improving the Prediction of the Hazard of Rock Bursts During Tunneling,
W89-00038 8E

POODLE, T.
Fresh Water Inflows to the Firth of Clyde,
W89-00801 2L

POURCHET, M.
Chernobyl 134Cs, 137Cs, and 210Pb in High Mountain Lake Sediment: Measurements and Modeling of Mixing Process,
W89-00271 5B

POWELL, D. B.
Hepatic Lesions in English Sole (Parophrys vetulus) from Commencement Bay, Washington (USA),
W89-00859 5C

POWELL, T. M.
Summer Dynamics of the Deep Chlorophyll Maximum in Lake Tahoe,
W89-00224 2H

POWER, G.
Prediction of Rainbow Trout Embryo Survival in Relation to Groundwater Seepage and Particle Size of Spawning Substrates,
W89-00326 2H

POWERS, B.
Sorption of Hydrophobic Chemicals from Water: A Hypothesis for the Mechanism of the Particle Concentration Effect,
W89-00585 5B

POXTON, M. G.
Distribution of Plaice Eggs and Larvae in the Clyde Sea Area,
W89-00829 2L

PRABHAKARA RAO, A. V. S.
Removal of Cadmium using Chitosan,
W89-00496 5D

PRASAD, G.
Removal of Chrome Dye from Carpet Effluents Using Coal: I,
W89-00630 5D

PRASAD, R.
Linear Root Water Uptake Model,
W89-00353 2I

Simplified Turbine Runner Shows Good Cavitation Resistance,
W89-01003 8C

PRESTON, D. R.
Novel Approach for Modifying Microporous Filters for Virus Concentration from Water,
W89-00332 5A

PRIBAN, K.
Evapotranspiration of a Willow Carr in Summer,
W89-00125 2D

Patterns of Temperature and Humidity in Wetland Biotopes,
W89-00124 2H

PRICE, A. G.
Prediction of Snowmelt Rates in a Deciduous Forest,
W89-01203 2C

PRIFTIS, A.
Assessment of the Toxicity of Heavy Metals to the Anaerobic Digestion of Sewage Sludge,
W89-00631 5D

PRIHA, M.
Mutagenicity in Pulp and Paper Mill Effluents and in Recipient,
W89-00370 5C

PRINS, C. J.
Innovative Septic System Management,
W89-00508 5D

PRINS, H. B. A.
Carbon Source of the Water Soldier, Stratiotes aloides L.,
W89-00128 2H

PRITCHARD, P. H.
Biotic and Abiotic Degradation Rates of Methyl Parathion in Freshwater and Estuarine Water and Sediment Samples,
W89-00601 5B

PROCOPIO, J. R.
Determination of Thiram in Water and Soils by Cathodic Stripping Voltammetry Based on Adsorptive Accumulation,
W89-01087 5A

PUANGMAHA, W.
River Basin Water Quality Management in Stochastic Environment,
W89-00490 5G

PUISEUX-DAO, S.
Use of Factorial Experimental Design to Evaluate How Biotic and Abiotic Factors Influence Cadmium Accumulation in the Unicellular Alga Dunaliella bioculata,
W89-01043 5B

PUJIN, V.
Some Hydrochemical, Hydrobiological, and Ichthyological Features of Yugoslav Part of the Danube Lasting for Several Years (Einige hydrochemische, hydrobiologische und ichthyologische Eigenschaften der jugoslawischen Donaustrecke in mehrjahrigem Zeitraum),
W89-00165 5C

PUJOS, M.
Suspended Matter and Bottom Deposits in the Mahury Estuarine System (French Guiana): Environmental Consequences,
W89-00003 2J

PYLES, M. R.
Flow Capacity of Culverts on Oregon Coast Range Forest Roads,
W89-00878 8B

QUENTIN, K.-E.
Hydrogeological and Hydrogeochemical studies of the Unsaturated Flow in a Gravel Aquifer: Part II. Results of Long Term Soil-hydrological Measurements (Hydrogeologische und Hydrochemische Untersuchungen in der Ungesaettigten Zone eines Kiesgrundwasserleiters: Teil II. Ergebnisse Langjaehriger Bodenhydrologischer Messungen),
W89-00503 2F

QUIGLEY, T. M.
Bacterial Water Quality Responses to Four Grazing Strategies: Comparisons with Oregon Standards,
W89-01170 5B

QUINN, T. P.
Homing of Adult Chinook Salmon after Brief Exposure to Whole and Dispersed Crude Oil,
W89-00375 5C

RADKEVICH, D. B.
Ultrasonic Flowmeter for Testing Units of Large Hydroelectric and Pumped-Storage Stations,
W89-01181 8C

RADOJEVIC, M.
Dissolution of Trace Metals from Particles of Industrial Origin and Its Influence on the Composition of Rainwater,
W89-01149 5B

RADUCA, C.
Interaction of Some Environmental Factors in the Danube Delta on the Delimitation of the Vital Space Occupied by the Reed, Mace Reed and Sedge Cenoses (Die Einwirkung einiger Umweltfaktoren des Donaudeltas auf die Ab-

grenzung des Lebensraumes von Schilf-, Rohrkolben- und Seggengesellschaften),
W89-00163 2H

RAFFAELLI, D.
Intertidal Macrofauna of Nigg Bay,
W89-00780 2L

RAGO, P. J.
Does pH Affect Fish Species Richness when Lake Area is Considered,
W89-00324 2H

RAI, D. N.
Statistical Correlations for Predicting the Partition Coefficient for Nonpolar Organic Contaminants Between Aquifer Organic Carbon and Water,
W89-00992 5B

RAI, H.
Measurement of Primary Productivity in a High-Rate Oxidation Pond (HROP),
W89-00213 2H

RAIA, J. C.
Determination of Naphthenic Acids in California Crudes and Refinery Wastewaters by Fluoride Ion Chemical Ionization Mass Spectrometry,
W89-00209 5A

RAJARATNAM, N.
Plunging and Streaming Flows in Pool and Weir Fishways,
W89-00904 2E

RAJCZY, M.
Role of Storms in the Summer Succession of the Phytoplankton Community in a Shallow Lake (Lake Balaton, Hungary),
W89-00232 2H

RAMACHANDRA RAO, A.
Maximum Entropy Spectral Analysis of Hydrologic Data,
W89-01248 2A

RAMAN, R. K.
Experiences of Long-term Destratification in a Water Supply Impoundment in Central Illinois,
W89-00403 5G

RAMIREZ, J.
Ex Post Analysis of Flood Control: Benefit-Cost Analysis and the Value of Information,
W89-00983 6C

RAMOS-CORMENZANA, A.
Characteristics of Soil after Pollution with Waste Waters from Olive Oil Extraction Plants,
W89-00602 5C

RAMOS, J. M.
Legionnaire's Disease in a Johannesburg Teaching Hospital,
W89-00450 5F

RAMSEY, R. H.
Intrapedal Macropore Distribution and Infiltration Rate of Three Friona Polypedons,
W89-00408 2G

RANDALL, C. F.
Studies on Epilithic and Epiphytic Diatoms in a Chalkstream: Comparative Estimates of Chlorophyll a and Its Derivatives,
W89-01186 2H

RANDALL, J. M.
Effects of River Discharge and Vertical Circulation on Aquatic Primary Production in a Turbid Louisiana (USA) Estuary,
W89-00005 2L

RANGO, A.
Progress in Developing an Operational Snowmelt-Runoff Forecast Model with Remote Sensing Input,
W89-00891 2A

RAO, G. J.
Simplified Turbine Runner Shows Good Cavitation Resistance,
W89-01003 8C

RAO, K. C.
Effects of Discontinuing Disinfection on a Receiving Water,
W89-00515 5D

RAO, P. S.
Pesticidal Effects on Chironomid Larvae,
W89-00079 5C

RAO, P. S. C.
Sorption Nonequilibrium During Solute Transport,
W89-00988 5B

RAO, S. V. R.
Remote Sensing Applications in Water Resource Prospecting and Management,
W89-00459 7B

RAST, W.
Eutrophication of Lakes and Reservoirs: A Framework for Making Management Decisions,
W89-00439 5C

RASTOSKUEV, B. A.
Experience in Operating Hydraulic Structures and Equipment of Hydroelectric Stations,
W89-00554 8C

RATAJCZYK, H.
Chemical Characteristics of Bottom Sediment Top Layer in Szczytno Male Lake,
W89-00237 2H

Chlorophyll Relationships in Letowo and Szczytno Male Lakes, with Trout Cage Culture,
W89-00262 2H

Primary Production in Lakes with Cage Trout Culture,
W89-00238 2H

RATH, L. C.
Spatial Patchiness in the Lacustrine Sedimentary Environment,
W89-01048 2H

RATZLAFF, J. R.
Variations of Runoff in the High Plains Section of the Smoky Hill Drainage, 1951-1980,
W89-00394 2A

RAVIKUMAR, G.
Effects of Lindane and Atropine Sulphate on the Tissues of the Fish, Anabas testudineus (Bloch): A Chronotoxicological Approach,
W89-00594 5C

RAY, P. K.
Sensitivity of Freshwater Pulmonate Snails, Lymnaea luteola L., to Heavy Metals,
W89-01154 5C

RAZUMOV, V. K.
Gas Shows during Construction of Hydraulic Tunnels,
W89-00071 8E

REBHUN, M.
Trihalomethane Formation in High-Bromide Lake Galilee Water,
W89-00426 5F

RECKHOW, K. H.
Comparison of Robust Bayes and Classical Estimators for Regional Lake Models of Fish Response to Acidification,
W89-00713 5C

RECKTENWALT, M. A.
Sequential Wet Air Regeneration of PAC from the Powdered Carbon-Activated Sludge Process,
W89-01137 5D

RECZYNSKA-DUTKA, M.
Chemical Mechanisms of Heavy Metal Transport in Waters of Mala Panew and Brynica Rivers (Silesia, Poland),
W89-00251 5B

Effect of Drainage Basin on Heavy Metal Concentrations in Stream Waters in the Niepolomice Forest,
W89-00260 5B

REDDING, J. M.
Physiological Effects on Coho Salmon and Steelhead of Exposure to Suspended Solids,
W89-00292 5C

REDDY, D. V.
Validity of the Environmental Chloride Method for Recharge Evaluation of Coastal Aquifers, India.
W89-00356 7B

REDDY, S. R.
Growth and Conversion Efficiency of the Catfish Heteropneustes fossilis (Bloch) Exposed to Sub-Lethal Concentrations of Sodium Pentachlorophenate,
W89-00243 5C

REED, S. C.
Use of Duckweed for Wastewater Treatment,
W89-01128 5D

REFSGAARD, J. C.
Estimation of Catchment Rainfall Uncertainty and its Influence on Runoff Prediction,
W89-00892 2A

REGIER, H. A.
Application of Ecological Modelling: Impact of Thermal Effluent on a Smallmouth Bass Population,
W89-00317 5C

REIML, D.
Frequent and Important Consequences from Increased Amounts of Liquid Manure (Haeufige und Wichtige Folgen Vermehrten Guelleanfalls),
W89-00500 5B

REINERTSEN, H.
Limnocorral Experiments in a Eutrophic Lake - Effects of Fish on the Planktonic and Chemical Conditions,
W89-00253 2H

RELIGA, K.
Changes in Phytoplankton Over a Ten-Year Period in a Lake Undergoing De-Eutrophication due to Surrounding Peat Bogs,
W89-00196 2H

REMBERGER, M.
Environmental Fate of Chloroguaiacols and Chlorocatechols,
W89-00369 5B

RENDALL, D.
Attached Algae of the Clyde and Garnock Estuaries,
W89-00807 5C

Sub-Littoral Fauna of the Inverness, Cromarty and Dornoch Firths,
W89-00784 2L

Water Quality in the Inverness and Beauly Firths,
W89-00789 5B

RENDON, L.
Infiltration under Ponded Conditions: 2. Infiltration Equations Tested for Parameter Time-Dependence and Predictive Use,
W89-00740 2G

RENEAU, R. B.
Shallowly Placed, Low Pressure Distribution System to Treat Domestic Wastewater in Soils with Fluctuating High Water Tables,
W89-01171 5D

REYES, S.
Southwest Branch of the North American Monsoon During Summer 1979,
W89-00845 2A

REYNOLDS, C. S.
Response of Phytoplankton Communities to Changing Lake Environments,
W89-00018 2H

Short-term Dynamics of a Melosira Population in the Plankton of an Impoundment in Central Chile,
W89-00214 2H

Vertical Distribution of Phytoplankton in a Stratified Lake (Lago Dom Helvecio, Southeastern Brazil) with Special Reference to the Metalimnion,
W89-00768 2H

REZNIKOVSKII, A. S.
Control of the Conditions for Input of Hydropower Into the Unified Power System of the U.S.S.R.,
W89-00034 8C

RIBI, G.
Dynamics of Hydra Populations in Lake Zurich, Switzerland, and Lake Maggiore, Italy,
W89-00692 2H

RICE, D. W.
Effects of Organic Contaminants on Reproduction of the Starry Flounder Platichthys stellatus in San Francisco Bay. I. Hepatic Contamination and Mixed-Function Oxidase (MFO) Activity During the Reproductive Season,
W89-00385 5C

RICE, G.
Reliability of Chemical Analyses of Water Samples: The Experience of the UMTRA Project,
W89-00941 5A

RICHARDS, R. C.
Seasonal Phytoplankton Demographic Processes and Experiments on Interspecific Competition,
W89-00906 2H

RICHARDSON, C. P.
Modified Fickian Model for Solute Uptake by Runoff,
W89-00486 5B

RICHARDSON, E. V.
Suspension of Large Concentrations of Sands,
W89-00900 2J

RICHARDSON, L. L.
Manganese Oxidation in pH and O2 Microenvironments Produced by Phytoplankton,
W89-01045 2K

RICHERSON, P. J.
Seasonal Phytoplankton Demographic Processes and Experiments on Interspecific Competition,
W89-00906 2H

Summer Dynamics of the Deep Chlorophyll Maximum in Lake Tahoe,
W89-00224 2H

RICKABAUGH, J.
Influence of Feeding Procedure on Microbial Reductions and Performance of Anaerobic Digestion,
W89-00511 5D

RIDD, P.
Outwelling from Tropical Tidal Salt Flats,
W89-00140 2L

RIJSTENBIL, J. W.
Phytoplankton Composition of Stagnant and Tidal Ecosystems in Relation to Salinity, Nutrients, Light and Turbulence,
W89-00001 2L

RILEY, R. G.
Leaching of Retorted Oil Shale: Assessing the Toxicity to Colorado Squawfish, Fathead Minnows, and Two Food-Chain Organisms,
W89-00329 5C

RINZEMA, A.
Effect of Sulphide on the Anaerobic Degradation of Propionate,
W89-00625 5D

RIQUELME, C. E.
Effects of Oil Contamination on Colonization of Marine Periphytic Microflora,
W89-00681 5C

RITMILLER, L. F.
Effects of Aquatic Humic Substances on Analysis for Hydrogen Peroxide Using Peroxidase-Catalyzed Oxidations of Triarylmethanes or p-Hydroxyphenylacetic Acid,
W89-00634 7B

RITZL, I.
Frequent and Important Consequences from Increased Amounts of Liquid Manure (Haeufige und Wichtige Folgen Vermehrten Guelleanfalls),
W89-00500 5B

ROBB, F. T.
Annual Cycle of Free-Floating Bacteria in the Bot River Estuary,
W89-00658 2L

Effect of Salinity and Temperature Variations on the Bacterial Population in the Bot River Estuary,
W89-00657 2L

ROBB, L.
Benthos of the Deeper Sediments of the Firth of Clyde, with Particular Reference to Organic Enrichment,
W89-00820 5C

ROBBINS, K. D.
Evaluating Peat-Mining Hydrology Using DRAINMOD,
W89-00755 4C

ROBERTS, C. H.
Annual Cycle of Free-Floating Bacteria in the Bot River Estuary,
W89-00658 2L

Effect of Salinity and Temperature Variations on the Bacterial Population in the Bot River Estuary,
W89-00657 2L

ROBERTS, D. A.
Patterns of Epipelic Algal Distribution in an Acidic Adirondack Lake,
W89-00298 2H

ROBERTSON, M. R.
Benthic Fauna of Sandy Bays, with Particular Reference to Irvine Bay,
W89-00819 5C

ROBINSON, J. A.
Statistical Considerations Associated with the Use of the Heterotrophic Activity Method for Estimating V sub max and K' for Aquatic Environments,
W89-00280 7C

ROBINSON, J. W.
Speciation Studies of Copper and Magnesium in Duckweed Extract Using Interfaced HPLC and Thermospray Neubulizer Flame AA,
W89-00886 5D

ROBINSON, R. A.
Microbial Pollution of Well Water in Southeastern Minnesota,
W89-00887 5B

ROCHE, M. A.
Water Resources, Salinity and Salt Yields of the Rivers of the Bolivian Amazon,
W89-01213 2E

ROCHET, M.
Community Structure of Zooplankton in Eastern Hudson Bay,
W89-01232 2L

ROCKOW, J. P.
Characterization of the Interaction Between Viruses and a Solid Polymeric Contact Disinfectant,
W89-00884 5F

RODRIGUEZ-ITURBE, E.
Fractal Nature of River Networks,
W89-00975 2E

RODRIGUEZ-ITURBE, I.
Evaluation of a Homogeneous Point Process Description of Arizona Thunderstorm Rainfall,
W89-00724 2B

Multidimensional Modeling of Cumulative Rainfall: Parameter Estimation and Model Adequacy through a Continuum of Scales,
W89-00706 2B

RODRIGUEZ, M. S.
Factors Affecting Nutrient Dynamics in a Piedmont North Carolina Reservoir,
W89-00187 2H

ROGERS, J.
Geomorphology, Offshore Bathymetry and Quaternary Lithostratigraphy around the Bot River Estuary,
W89-00649 2L

ROGERS, K. H.
Roles of Sedimentation and Plant Growth in Changing Flow Patterns in the Okavango Delta, Botswana,
W89-00457 2J

ROGERS, W. F.
Drainage Basin Peak Discharge Rating Curve,
W89-00913 2E

ROMAN, L.
Interaction of Some Environmental Factors in the Danube Delta on the Delimitation of the Vital Space Occupied by the Reed, Mace Reed and Sedge Cenoses (Die Einwirkung einiger Umweltfaktoren des Donaudeltas auf die Abgrenzung des Lebensraumes von Schilf-, Rohrkolben- und Seggengesellschaften),
W89-00163 2H

ROMAN, T.
Interaction of Some Environmental Factors in the Danube Delta on the Delimitation of the Vital Space Occupied by the Reed, Mace Reed and Sedge Cenoses (Die Einwirkung einiger Umweltfaktoren des Donaudeltas auf die Abgrenzung des Lebensraumes von Schilf-, Rohrkolben- und Seggengesellschaften),
W89-00163 2H

RONEN, D.
Microscale Haline Convection - A Proposed Mechanism for Transport and Mixing at the Water Table Region,
W89-00718 2F

RONGFU, Y.
Determination of Probability Weighted Moments with the Incorporation of Extraordinary Values into Sample Data and Their Application

to Estimating Parameters for the Pearson Type Three Distribution,
W89-01199 7C

ROOM, P. M.
Chemical Environment of Salvinia molesta Mitchell: Ionic Concentrations of Infested Waters,
W89-00106 5B

Equations Relating Growth and Uptake of Nitrogen by Salvinia molesta to Temperature and the Availability of Nitrogen,
W89-00111 2H

Nitrogen, Phosphorus and Potassium in Salvinia molesta Mitchell in the Field: Effects of Weather, Insect Damage, Fertilizers and Age,
W89-00113 2H

RORSLETT, B.
Lake Enrichment by Submersed Macrophytes: A Norwegian Whole-Lake Experience with Elodea canadensis,
W89-00131 2H

ROSE, F. L.
Diel and Seasonal Carbon Budgets in Two Cold Spring Ecosystems,
W89-00177 2H

ROSHCHUPKIN, D. V.
Excavation of Heavy Soils by Dredges,
W89-00068 8H

ROSICH, R. S.
Controlling Swampy Odors in Drinking Water,
W89-00425 5F

ROSINSKI, J. M.
Comparisons of RADM and Oscar Precipitation Chemistry Data,
W89-00433 5B

ROSIU, C. J.
Comparison of Three Sediment Bioassay Methods Using Detroit River Sediments,
W89-01097 5A

ROSS, J. D.
Vertical Variability of Soil Properties in a Small Watershed,
W89-00354 2G

ROSTAD, C. E.
Creosote Compounds in Snails Obtained from Pensacola Bay, Florida, near an Onshore Hazardous-Waste Site,
W89-00611 5B

ROULET, N. T.
Runoff Generation in a Low Arctic Drainage Basin,
W89-01207 2A

ROUVALIS, M. C.
Restoration of Wetlands under Section 404 of the Clean Water Act: An Analytical Synthesis of Statutory and Case Law Principles,
W89-01189 6E

ROWE, P. M.
Dispersal and Recruitment of Fiddler Crab Larvae in the Delaware River Estuary,
W89-01039 2L

RUBANIK, M. N.
Filterless Revetment of the Slopes of Dikes at Pumped-storage Station Reservoirs,
W89-00058 8A

RUBINSHTEIN, M. I.
Control of the Conditions for Input of Hydropower Into the Unified Power System of the U.S.S.R.,
W89-00034 8C

RUDD, J. W. M.
Disruption of the Nitrogen Cycle in Acidified Lakes,
W89-00451 5C

RUDENSKII, M. Y.
Increase of the Reliability and Convenience of Operation of the Group Active Power Regulation System of a Hydroelectric Station,
W89-01179 8C

RUF, C.
Role of Economic Benefits Analysis in Funding Marine Combined Sewer Overflow Projects - Case Study of Boston Harbor,
W89-01132 6C

RYABTSEV, G. A.
Manufacture of Polyethylene Seals for High-head Gates of Hydraulic Structures,
W89-00043 8G

RYBICKI, N. B.
Effect of Sediment Depth and Sediment Type on the Survival of Vallisneria americana Michx Grown from Tubers,
W89-00114 2H

Effects of Grazers and Light Penetration on the Survival of Transplants of Vallisneria americana Michx in the Tidal Potomac River, Maryland,
W89-00108 2H

RYHINER, G.
Operation of a Three-Phase Biofilm Fluidized Sand Bed Reactor for Aerobic Wastewater Treatment,
W89-00747 5D

SAAD, M.
Application of Principal Component Analysis to Long-Term Reservoir Management,
W89-00698 6A

SAGFORS, P. E.
High Molar Mass Lignin in Bleached Kraft Pulp Mill Effluents,
W89-00361 5A

SAGRAVES, B. R.
Financing Strategies for Small Systems,
W89-01113 5F

SAINT-PAUL, U.
Diurnal Distribution and Behavioral Responses of Fishes to Extreme Hypoxia in an Amazon Floodplain Lake,
W89-00331 2H

SAKSHAUG, E.
Effect of Light Regime upon Growth Rate and Chemical Composition of a Clone of Skeletonema costatum from the Trondheimsfjord, Norway,
W89-00212 2L

SAKURAI, K.-I.
Characteristic Features of Supercooled Raindrops in the Mid-Winter Season of Arctic Canada,
W89-00418 2B

SALAS, J. D.
Multivariate Periodic ARMA (1,1) Processes,
W89-00967 7B

SALEM, S. B.
Comparison of Two Methods for Summarizing Hydraulic Conductivities of a Layered Soil,
W89-00970 2G

SALIBA, B. C.
Do Water Market Prices Appropriately Measure Water Values,
W89-00837 6D

SALIHOGLU, I.
Long Term Impact of Dissolved Dispersed Petroleum Hydrocarbons (DDPH) in Gulf of Iskenderun,
W89-00567 5B

Two Toxicants, Mercury and Tin in the Gulf of Iskenderun,
W89-00570 5B

SALMON, J. D.
Hurricane-Related Morphodynamics and Implications for Hazard Mitigation, Perdido Key, Florida, U.S.A.,
W89-00291 6B

SALTALAMACCHIA, G.
Definition of a Model for Monitoring the Chemical and Chemical-Physical Characteristics of Deep Drinking Waters,
W89-00927 7C

SAMANIDOU, V.
Comparative Study of Heavy Metals Pollution in Various Rivers and Lakes of Northern Greece,
W89-00571 5B

SAMARA, C.
Preconcentration of Heavy Metals in Natural Waters with Hydrazones Supported on Silica Gel,
W89-00568 5A

SAMMAL, A. S.
Calculation of Pressure Tunnel Linings with Consideration of Consolidation Grouting of the Rocks,
W89-00547 8C

SAMOILOFF, M. R.
Is Water a Relevant Sampling Medium for Toxic Chemicals: An Alternative Environmental Sensing Strategy,
W89-01162 5A

SAMPSON, P. D.
Changes in Rainwater Acidity Associated with Closure of a Copper Smelter,
W89-00272 5B

SANCHEZ, H.
Twinning: Utility Pairing,
W89-00424 5F

SAND-JENSEN, K.
High Rates of Production and Mortality of Submerged Sparganium emersum Rehman during Its Short Growth Season in a Eutrophic Danish Stream,
W89-00099 2H

SANDER, G. C.
Air and Water Flow: I. Horizontal Flow with an Arbitrary Flux Boundary Condition,
W89-00347 2G

Air and Water Flow: II. Gravitational Flow with an Arbitrary Flux Boundary Condition,
W89-00348 2G

Extension of the Fujita Solution to Air and Water Movement in Soils,
W89-00725 2G

SANDERS, R. W.
Tintinnids and Other Microzooplankton - Seasonal Distributions and Relationships to Resources and Hydrography in a Maine Estuary,
W89-00223 2L

SANDERSON, H. R.
Bacterial Water Quality Responses to Four Grazing Strategies: Comparisons with Oregon Standards,
W89-01170 5B

SANDERSON, R. D.
Formation of Hydrous Zirconium (IV) Oxide Polyelectrolyte Membranes, I. Poly (itaconic acid) and Poly (acrylic-co-itaconic acid),
W89-01062 3A

SANDSTROM, M. W.
Outwelling from Tropical Tidal Salt Flats,
W89-00140 2L

SANDSTROM, O.
Effects of a Bleached Pulp Mill Effluent on Growth and Gonad Function in Baltic Coastal Fish,
W89-00367 5C

SANFORD, W.
Analysis of ppb Levels of Organics in Water by Means of Purge-and-Trap, Capillary Gas Chromatography and Selective Detectors,
W89-00288 5A

SANT'ANNA, G. L.
Liquid Effluents of the Fish Canning Industries of Rio de Janeiro State: Treatment Alternatives,
W89-00646 5D

SANTODONATO, J.
Comparison of Drinking Water Mutagenicity with Leaching of Polycyclic Aromatic Hydrocarbons from Water Distribution Pipes,
W89-00619 5C

SAPLYUKOV, F. B.
Calculation of the Suspended Load in Rivers and Canals,
W89-00552 7B

SARKAR, A.
Effects of Light Intensity on Growth of Azolla pinnata Cultured in Effluent Collected from the Banka Stream in West Bengal, India,
W89-00127 5C

SATO, T.
Photochemical Reaction of Biphenyl in Water Containing Nitrite or Nitrate Ion,
W89-00593 5B

SAVERIO CIVILI, F.
Coordinated Programme for Research and Monitoring of Pollution in the Mediterranean,
W89-00582 5A

SAWICKA, E.
Chemistry of Atmospheric Precipitation in the Babia Gora National Park,
W89-00082 5B

SAWYER, P. E.
Recurrence of Daphnia rosea in Lake Tahoe: Analysis of a Population Pulse,
W89-00216 2H

SAXENA, J.
Comparison of Drinking Water Mutagenicity with Leaching of Polycyclic Aromatic Hydrocarbons from Water Distribution Pipes,
W89-00619 5C

SAYDAM, C.
Long Term Impact of Dissolved Dispersed Petroleum Hydrocarbons (DDPH) in Gulf of Iskenderun,
W89-00567 5B

Two Toxicants, Mercury and Tin in the Gulf of Iskenderun,
W89-00570 5B

SAYLER, G. S.
Conjugal Transfer of R68.45 and FP5 between Pseudomonas aeruginosa Strains in a Freshwater Environment,
W89-00728 5B

SCALISI, G.
Modern Management Standards of Water Network Register (Criteres Modernes de Gestion du Cadastre des Reseaux d'Eau),
W89-00919 5F

SCASCIGHINI, C.
Dynamics of Hydra Populations in Lake Zurich, Switzerland, and Lake Maggiore, Italy,
W89-00692 2H

SCHAEFFER, D. J.
Quality Control Approach to NPDES Compliance Determination,
W89-01136 5D

SCHAEFFER, D. L.
New Measure of Interdependence Among Several Pollutants,
W89-01131 5D

SCHAFER, A. E.
Freshwater Mollusks as Indicators of Trophic Conditions in Coastal Lakes of Southern Brazil (Moluscos Dulceaquicolas Como Indicadores de Condicoes Troficas em Lagoas Costeiras do Sul do Brasil),
W89-00008 5A

SCHALLA, R.
Sensitivity of Four Monitoring Well Sampling Systems to Low Concentration of Three Volatile Organics,
W89-00944 5A

SCHANZ, F.
Measurement of Primary Productivity in a High-Rate Oxidation Pond (HROP),
W89-00213 2H

Periphyton Diatom Communities and Trophic States of Three Shallow Lakes in the Pfynwald Region of Canton Valais, Switzerland,
W89-00195 2H

SCHARFENAKER, M. A.
AWWA Small Systems Program,
W89-01114 5F

SCHECTER, A.
Transient Liver Pathology in Patients Consuming Water from a Private Well Contaminated by PCBs from a Submersible Water Pump,
W89-00558 5C

SCHEFFE, R. D.
Drainage Basin Control of Acid Loadings to Two Adirondack Lakes,
W89-00710 5B

SCHENK, C. J.
Stokes Surfaces and the Effects of Near-Surface Groundwater-Table on Aeolian Deposition,
W89-00410 2J

SCHINDLER, D. W.
Disruption of the Nitrogen Cycle in Acidified Lakes,
W89-00451 5C

SCHNABEL, R. R.
Chemical-Hydrologic Interactions in the Near-Stream Zone,
W89-00717 2E

SCHNOOR, J. L.
Role of Chemical Weathering in the Neutralization of Acidic Deposition,
W89-00696 5B

Simulation Model for Biotransformation of Xenobiotics and Chemotaxis in Soil Columns,
W89-00989 5B

SCHOENBERG, S. A.
Adaptation of Phytoplankton-Degrading Microbial Communities to Thermal Reactor Effluent in a New Cooling Reservoir,
W89-00336 5C

SCHOENENBERGER, M.
Fine Bubble Aeration: Considerations in Design and Operation,
W89-01101 5D

SCHOER, J.
Investigation of Transport-Processes along the Elbe River Using Chernobyl Radionuclides as Tracers,
W89-00636 5B

SCHOLER, P. J.
Effects of Acidification on Metal Budgets of Lakes and Catchments,
W89-00207 5C

SCHOLZ, B.
Destruction of Polychlorinated Dibenzo-p-Dioxins and Dibenzofurans in Contaminated Water Samples Using Ozone,
W89-00606 5D

Determination of Substituted Aromatic Amines in Water and Sediment Samples,
W89-00738 5A

SCHOMAKER, J. H.
Identifying Critical Issues in Recreation Planning and Management: Improving the Management-Research Partnership,
W89-00873 6A

SCHOOR, J. L.
Waste Allocation Simulation Models,
W89-01234 5D

SCHRAA, G.
Simulation Model for Biotransformation of Xenobiotics and Chemotaxis in Soil Columns,
W89-00989 5B

SCHRECK, C. B.
Physiological Effects on Coho Salmon and Steelhead of Exposure to Suspended Solids,
W89-00292 5C

SCHRODER, D.
Bromothymol-Blue Test: A Simple Algal Bioassay and its Use for Herbicide Screening,
W89-00192 5A

SCHROEDER, D. C.
Fate of Alachlor during Treatment of Public Water Supplies,
W89-00395 5F

SCHROEDER, R.
Attempt to Estimate the Fish Stock and the Sustainable Yield of Lake Ziway and Lake Abaya, Ethiopian Rift Valley,
W89-00178 2H

SCHROEDER, W. H.
Field Measurements of Water-Air Exchange of Mercury in Freshwater Systems,
W89-00640 5A

SCHUH, W. M.
In-Situ Method for Monitoring Layered Hydraulic Impedance Development During Artificial Recharge with Turbid Water,
W89-01205 2F

SCHULTZ-BENKER, P.
Macroinvertebrate Populations in a Thermally Impacted Reservoir,
W89-00397 5C

SCHULTZ, G. A.
Remote Sensing in Hydrology,
W89-01019 2A

SCHULTZ, R. M.
Design Considerations for Package Water Treatment Systems,
W89-01117 5F

SCHUMANN, T.
Aerosol and Hydrometeor Concentrations and Their Chemical Composition during Winter Precipitation along a Mountain Slope: I. Temporal Evolution of the Aerosol, Microphysical and Meteorological Conditions,
W89-01150 2B

SCHURTER, M.
Origin and Size of Hypolimnic Mixing in Urnersee, the Southern Basin of Vierwaldstattersee (Lake Lucerne),
W89-00023 2H

SCHUSTER, R. L.
Formation and Failure of Natural Dams,
W89-00470 2J

SCHUURKES, J. A. A.
Role of External Ammonium Inputs in Freshwater Acidification,
W89-00024 5B

SCHUURKES, J. A. A. R.
Ammonium and Nitrate Uptake by Aquatic Plants from Poorly Buffered and Acidified Waters,
W89-00112 5C

SCHWARTZ, F. W.
Contaminant Hydrogeology Dollars and Sense,
W89-01028 5B

Continuum Approach for Modeling Mass Transport in Fractured Media,
W89-00980 5B

SCHWARTZBROD, J.
Viability Determination of Ascaris Eggs Recovered from Waste-Water,
W89-00644 5A

SCHWEBACH, G.
Risk: A Key Water Policy Issue,
W89-01123 6D

SCHWENCKE-HOFMANN, J.
Seasonal Fluctuations in the Species Composition of Phytoplankton and Phytobenthos in the Lobau Near Vienna (Jahreszeitliche Schwankungen in der Zusammensetzung des Phytoplanktons und Phytobenthos in Altwassern der Lobau bei Wien),
W89-00166 2H

SCHWERTMANN, U.
Iron Oxide Formation in Artificial Ground Waters,
W89-00687 2F

SCHWINGHAMER, P.
Adventures in Holistic Ecosystem Modelling: The Cumberland Basin Ecosystem Model,
W89-00675 2L

SCIFRES, J.
Effect of Sodium Nitrate and Gypsum on Infiltration and Erosion of a Highly Weathered Soil,
W89-00409 2G

SCUDLARK, J. R.
Atmospheric Deposition of Arsenic and Association with Acid Precipitation,
W89-00431 5B

SEELY, M. K.
Predictability of Two Moisture Sources in the Namib Desert,
W89-00455 2B

SEGO, D. C. C.
Procedure for Evaluating Municipal Solid Waste Leachate Components Capable of Causing Volume Shrinkage in Compacted Clay Soils,
W89-00621 5E

SEHGAL, H. S.
Thermal Ecology of Surinsar, a Subtropical Freshwater Lake in Jammu, India,
W89-00242 2H

SEIDOV, A. G.
Introduction of New Technology on the Construction of the Shamkhor Hydroelectric Station,
W89-00039 8A

SEIKE, Y.
Nitrogen Metabolism in the Brackish Lake Nakanoumi. III. Nitrification-Dentrification in Low Concentration of Dissolved Oxygen, (in Japanese),
W89-00769 2H

SEIP, H. M.
Assessing the Birkenes Model of Stream Acidification Using a Multisignal Calibration Methodology,
W89-00974 7B

SELIM, H. M.
Water Flow in Layered Soils with Sloping Surface,
W89-00752 2G

SELLERS, W. D.
El Nino and Its Effect on Precipitation in Arizona and Western New Mexico,
W89-00474 2B

SELLNER, K. G.
Effects of Increasing Salinity on a Cyanobacteria Bloom in the Potomac River Estuary,
W89-00231 2H

SEMINARA, M.
Seasonal Changes of the Profundal Macrobenthic Community in a Polluted Lake,
W89-00693 5C

SEPPANEN, A.
Leaching of Mercury from Peat Soil,
W89-00592 5B

SERAFINI, M. C.
Screened Auger Sampling: The Technique and Two Case Studies,
W89-00945 5A

SERVAIS, P.
Nitrogen Budget of the Scheldt Hydrographical Basin,
W89-00155 5B

SEVEROV, A. P.
Ultrasonic Flowmeter for Testing Units of Large Hydroelectric and Pumped-Storage Stations,
W89-01181 8C

SEVILLA ESCRIBANO, M. T.
Determination of Thiram in Water and Soils by Cathodic Stripping Voltammetry Based on Adsorptive Accumulation,
W89-01087 5A

SEWELL, W. R. D.
Politics of Hydro-Megaprojects: Damming with Faint Praise in Australia, New Zealand, and British Columbia,
W89-00836 6E

SEXTON, J. R.
Regulation of the River Thames: A Case Study on the Teddington Flow Proposal,
W89-00955 4A

SHAFFER, G. P.
K-Systems Analysis for Determining the Factors Influencing Benthic Microfloral Productivity in a Louisiana Estuary, USA,
W89-01035 2L

Water Column Productivity Attributable to Displaced Benthic Diatoms in Well-Mixed Shallow Estuaries,
W89-00297 2L

SHAINOVA, G. I.
Small Hydroelectric Stations and Prospects of Their Development,
W89-00059 8C

SHAKARS, I. E.
Some Results of Investigating the State of the Powerhouse of the Plyavinyas Hydroelectric Station,
W89-01180 8D

SHALABY, A. S.
Horizontal Infiltration of Water in Soil Columns as Affected by a Gel-Forming Conditioner,
W89-00741 2G

SHANE, L. A.
Sedimentation of 74 PCB Congeners in the Upper Hudson River,
W89-00584 5B

SHANGHUI, Z.
Study of Modern Vicissitudes of the Jianghan Lake Group by Using Remote Sensing Techniques,
W89-00542 2H

SHANHOLTZ, V. O.
Evaluation of Vegetation Filter Strips as a Best Management Practice for Feed Lots,
W89-01125 5G

SHANNON, M. J. R.
Immobilization of Leachable Toxic Soil Pollutants by Using Oxidative Enzymes,
W89-00341 5G

SHAW, B.
Global Environment: A Proposal to Eliminate Marine Oil Pollution,
W89-00521 5G

SHAW, D. M.
Pollution Control and Environmental Planning for the Beatrice Oilfield and Nigg Oil Terminal,
W89-00788 5G

SHEA, D.
Determination of Hydrophilic Thiols in Sediment Porewater Using Ion-Pair Liquid Chromatography Coupled to Electrochemical Detection,
W89-00266 7B

SHEAIL, J.
River Regulation in the United Kingdom: An Historical Perspective,
W89-00949 4A

SHEEHAN, R. J.
Impacts of Navigation on Riverine Fish Production in the United States,
W89-00248 6G

Influence of pH and Ammonia Salts on Ammonia Toxicity and Water Balance in Young Channel Catfish,
W89-00377 5C

SHEERIN, J. G.
Effects of Discontinuing Disinfection on a Receiving Water,
W89-00515 5D

SHEFFIELD, A.
Effects of Three Organics on Selected Physical Properties of Type I Portland Cement,
W89-00994 5E

SHEPHERD, G. W.
Identification of Rainfall Type From Weather Radar Data,
W89-00842 2B

SHERRARD, J. H.
Evaluation of Vegetation Filter Strips as a Best Management Practice for Feed Lots,
W89-01125 5G

SHEVCHENKO, V. A.
Possibility of Using Radioactively Polluted Waterbodies for Fish Culture,
W89-01193 3C

SHIELD, J. D.
Acute Toxicities of Eleven Metals to Early Life-History Stages of the Yellow Crab Cancer anthonyi,
W89-00386 5C

SHIELDS, D. H.
Creep of Ice Measured with the Pressuremeter,
W89-00387 2C

SHIGEOKA, T.
Evaluation of Aquatic Environmental Fate of 2,4,6-Trichlorophenol with a Mathematical Model,
W89-00616 5B

SHIH, S. F.
Satellite Data and Geographical Information System for Land Use Classification,
W89-00756 7B

SHILLER, A. M.
Variability of Dissolved Trace Metals in the Mississippi River,
W89-01075 5B

SHIMODAIRA, I.
Seasonal Change of Iron and Manganese in Lake Fukami-ike: Occurrence of Turbid Manganese Layer,
W89-00770 2H

SHIN, H. K.
Ammonia Nitrogen Removal in Attached-Growth Ponds,
W89-00489 5D

SHINDE, V. M.
Simultaneous Gas Chromatographic Determination of Nitrobenzene and 2,4-Dinitrophenol in Nitrobenzene Manufacturing Plant Wastewater,
W89-00479 5A

SHINRIKI, N.
Mechanism of Inactivation of Tobacco Mosaic Virus with Ozone,
W89-01229 5F

SHIRLEY, E.
Survey of the International Law of Rivers,
W89-00835 6E

SHORT, F. T.
Effects of Sediment Nutrients on Seagrasses: Literature Review and Mesocosm Experiment,
W89-00523 2L

SHUIFER, M. I.
Calculation of Seismic Safety of Tunnels During Blasting,
W89-00037 8E

SHUKLA, S. P.
Toxicity Bioassay of Technical and Commercial Formulations of Carbaryl to the Freshwater Catfish, Clarias batrachus,
W89-00086 5C

SHUL'MAN, S. G.
Estimation of the Reliability of Earth Dams with Consideration of Seismic Loads,
W89-00557 8E

SHULUAN, L.
Distribution of Agglutinated Foraminifera in Bottom Sediments of the Zhujiang River Estuary, (in Chinese),
W89-00203 2L

SHUMAN, M. S.
Copper Binding by Dissolved Organic Matter: I. Suwannee River Fulvic Acid Equilibria,
W89-01077 5B

Copper Binding by Dissolved Organic Matter: II. Variation in Type and Source of Organic Matter,
W89-01078 5B

SHUTER, B. J.
Application of Ecological Modelling: Impact of Thermal Effluent on a Smallmouth Bass Population,
W89-00317 5C

SHUTTLEWORTH, W. J.
Macrohydrology: The New Challenge for Process Hydrology,
W89-01012 2A

SHUVAL, H. I.
Association Between Seawater Pollution as Measured by Bacterial Indicators and Morbidity Among Bathers at Mediterranean Bathing Beaches of Israel,
W89-00579 5C

SIDDEEK, F. Z.
Water Management for Lowland Rice Irrigation,
W89-00750 3F

SIDIROPOULOS, E.
Sensitivity Analysis of Closed-Form Analytical Hydraulic Conductivity Models,
W89-01204 2G

SIEBURTH, J. M.
Phagotrophic Phototrophs: The Ecological Significance of Mixotrophy,
W89-00384 2H

SIEGEL, D. I.
Simulation of Regional Ground Water Flow in Bedrock, Southwestern New York-Northwestern Pennsylvania,
W89-00882 2F

SIGG, L.
Binding of Heavy Metals to Algal Surfaces,
W89-01227 5B

SIGHINOLFI, G. P.
Sequential Extraction of Phosphorus and Heavy Metals from Sediments: Methodological Considerations,
W89-00629 5A

SIKORA, H.
Acute Toxicity of Ammonia to Common Carp (Cyprinus carpio L.),
W89-00244 5C

SILVA, J. A.
Sewage Sludge-Soil Interactions as Measured by Plant and Soil Chemical Composition,
W89-01161 5E

SILVERT, W. L.
Adventures in Holistic Ecosystem Modelling: The Cumberland Basin Ecosystem Model,
W89-00675 2L

SIMMONS, M. A.
Avoidance of a Water-Soluble Fraction of Coal Liquid by Fathead Minnows,
W89-00321 5C

Sensitivity of Four Monitoring Well Sampling Systems to Low Concentration of Three Volatile Organics,
W89-00944 5A

SIMON, M.
Bacterial Response to Seasonal Changes in Primary Production and Phytoplankton Biomass in Lake Constance,
W89-00225 2H

SIMS, R. C.
Fate and Transport of Organics in Soil: Model Predictions and Experimental Results,
W89-01239 5B

SINCLAIR, C. D.
Assessment of Flood Frequency Models Using Empirical Distribution Function Statistics,
W89-00976 2E

Location-Invariant Plotting Positions for PWM Estimation of the Parameters of the GEV Distribution,
W89-00351 2E

SINGH, A. R.
Simple and Efficient New Design of the Submersible Stirrer for the YSI Dissolved Oxygen Meter,
W89-00936 7B

SINGH, N.
Developing Release Schedules for a Gated Spillway,
W89-01006 8A

SINGH, V. N.
Removal of Chrome Dye from Carpet Effluents Using Coal: I,
W89-00630 5D

SINGH, V. P.
Drainage Basin Peak Discharge Rating Curve,
W89-00913 2E

SISSON, J. B.
Comparison of Two Methods for Summarizing Hydraulic Conductivities of a Layered Soil,
W89-00970 2G

SITAR, N.
Nonaqueous Phase Liquid Transport and Cleanup: I. Analysis of Mechanisms,
W89-00968 5B

Nonaqueous Phase Liquid Transport and Cleanup: II. Experimental Studies,
W89-00969 5B

SIVAPALAN, M.
Hydrological Heterogeneity Catchment Morphology and Catchment Response,
W89-01024 2A

SKAGGS, R. W.
Evaluating Peat-Mining Hydrology Using DRAINMOD,
W89-00755 4C

SKALSKI, J. R.
Avoidance of a Water-Soluble Fraction of Coal Liquid by Fathead Minnows,
W89-00321 5C

SKIBA, S. I.
Gas Shows during Construction of Hydraulic Tunnels,
W89-00071 8E

SKOVMAND FRIIS, N. J.
Leaf Production and Nitrogen and Phosphorus Tissue Content of Littorella uniflora (L.) Aschers. in Relation to Nitrogen and Phosphorus Enrichment of the Sediment in Oligotrophic Lake Hampen, Denmark,
W89-00101 5C

SKURLATOV, Y. I.
Effects of Aquatic Humic Substances on Analysis for Hydrogen Peroxide Using Peroxidase-Catalyzed Oxidations of Triarylmethanes or p-Hydroxyphenylacetic Acid,
W89-00634 7B

SLANINA, Z.
Theoretical Evaluation of Water Oligomer Populations in the Earth's Atmosphere,
W89-00763 2B

SLEIGH, M. A.
Feeding of a Freshwater Flagellate, Bodo saltans, on Diverse Bacteria,
W89-00381 2H

SLIJKHUIS, H.
Effect of Environmental Conditions on the Occurrence of Microthrix parvicella in Activated Sludge,
W89-01217 5D

SLINN, W. G. N.
Acidic Deposition Distribution and Episode Statistics from the MAP3S Network Database,
W89-01151 5B

SLOAN, R. J.
Organochlorine and Mercury Residues in Wild Mink and Otter: Comparison with Fish,
W89-01093 5B

SLODCZYK, S.
Application of Biologically Activated Sorptive Columns for Textile Waste Water Treatment,
W89-00632 5D

SMALL, J. G. C.
Spatial Patterns of N Fixation (Acetylene Reduction) along Environmental Gradients in a Warm-Temperate Estuary,
W89-00475 2L

SMARDA, J.
SEM-Analysis of Colonies of the Cyanophyte Nodularia Water Bloom from Baltic Sea,
W89-00193 2H

SMART, M. M.
Biomass and Nutritive Potential of Vallisneria americana Michx in Navigation Pool 9 of the Upper Mississippi River,
W89-00093 2H

SMAYDA, T. J.
Nitrogen Dynamics in Lower Narragansett Bay: II. Phytoplankton Uptake, Depletion Rates of Nitrogenous Nutrient Pools, and Estimates of Ecosystem Remineralization,
W89-00215 2L

SMIT, A.
Polychlorinated Biphenyls in the Kupa River, Croatia, Yugoslavia,
W89-00609 5B

SMITH, B. R.
Developing and Assessing a Model of Residential Water Conservation,
W89-00881 3D

SMITH, C. D.
Outlet Structure Design for Conduits and Tunnels,
W89-00307 8A

SMITH, D. B.
National Field Evaluation of a Defined Substrate Method for the Simultaneous Enumeration of Total Coliforms and Escherichia coli from Drinking Water: Comparison with the Standard Multiple Tube Fermentation Method,
W89-00337 5A

SMITH, D. W.
Procedure for Evaluating Municipal Solid Waste Leachate Components Capable of Causing Volume Shrinkage in Compacted Clay Soils,
W89-00621 5E

SMITH, J. D.
Shear Instability in a Highly Stratified Estuary,
W89-00415 2L

SMITH, J. N.
Basin Sedimentation and the Growth of Prograding Deltas,
W89-00832 2J

SMITH, J. S.
Coastal Topography of the Moray Firth,
W89-00775 2L

SMITH, K.
Climate of the Estuary and Firth of Clyde,
W89-00800 2L

SMITH, L.
Continuum Approach for Modeling Mass Transport in Fractured Media,
W89-00980 5B

Groundwater Flow Systems in Mountainous Terrain: 1. Numerical Modeling Technique,
W89-00708 2F

Groundwater Flow Systems in Mountainous Terrain: 2. Controlling Factors,
W89-00709 2F

SMITH, P. G.
Effect of Upgrading a Tubewell Water Supply in Rural Areas of Bangladesh,
W89-00920 5F

SMITH, R. A.
Trends in Lead Concentrations in Major U.S. Rivers and Their Relation to Historical Changes in Gasoline-Lead Consumption,
W89-00868 5B

SMITH, R. J. F.
Effects of Acute Exposure to Acidified Water on the Behavorial Response of Fathead Minnows, Pimephales Promelas, to Alarm Substance (Schreckstoff),
W89-01092 5C

SMITH, W. D.
Tumor Frequencies and Contaminant Concentrations in Brown Bullheads from an Industrialized River and a Recreational Lake,
W89-00028 5C

SMYTH, J. C.
Patterns of Association Between Birds and Invertebrates in the Clyde Estuary,
W89-00811 2L

SNEDDON, J.
Binding and Removal of Aluminum Ions in Waters by an Algal Biomass.
W89-00478 5F

SNODGRASS, W. J.
Biochemical Models for the Hypolimnetic Oxygen Depletion in Lakes Impacted by Wastewater Discharges: 1. Alternative models,
W89-00186 5C

Biochemical Models for the Hypolimnetic Oxygen Depletion in Lakes Impacted by Wastewater Discharges: 2. Phytoplankton Biomass Model,
W89-00189 5C

SNOEYINK, V. L.
Sequential Wet Air Regeneration of PAC from the Powdered Carbon-Activated Sludge Process,
W89-01137 5D

SNYDER, B. J.
Induced Resistance to Polychlorinated Biphenyls Confers Cross-Resistance and Altered Environmental Fitness in a Marine Diatom,
W89-00860 5C

SNYMAN, H. A.
Determination of Water Use Efficiency of Veld in the Central Orange Free State from Evapotranspiration Measurements (Bepaling van Waterverbruiksdoeltreffendheid van Veld in die Sentrale Oranje-Vrystaat Vanaf Evapotranspirasiemetings),
W89-00934 2D

SOARES, G. M.
Diurnal Distribution and Behavioral Responses of Fishes to Extreme Hypoxia in an Amazon Floodplain Lake,
W89-00331 2H

SOARES, J. V.
Estimation of Bare Soil Evaporation from Airborne Measurements,
W89-00352 7B

SOBECKY, P.
Adaptation of Phytoplankton-Degrading Microbial Communities to Thermal Reactor Effluent in a New Cooling Reservoir,
W89-00336 5C

SOBEY, R. J.
Horizontal Round Buoyant Jet in Shallow Water,
W89-00902 5E

SOBKALOV, P. F.
Use of Clay Soils in the Construction of Cutoff Curtains,
W89-00549 8D

SOBSEY, M. D.
Septic System Performance on a Coastal Barrier Island,
W89-01163 5D

SODHI, P. S.
Thermal Ecology of Surinsar, a Subtropical Freshwater Lake in Jammu, India,
W89-00242 2H

SOEDER, C. J.
Bromothymol-Blue Test: A Simple Algal Bioassay and its Use for Herbicide Screening,
W89-00192 5A

SOGAARD, H.
Activity Assessment in Drinking Water Bacteriology - A Comparison of Methods and Possibilities,
W89-00928 5A

SOKOLOVA, Y. A.
Effective Coatings for Hydraulic Structures,
W89-00075 8G

SOLDEVILLA, M.
Heavy Metal Pollution in the Guadiamar River and the Guadalquivir Estuary (South West Spain),
W89-00573 5B

SOMERVILLE, A. C.
Determination of Naphthenic Acids in California Crudes and Refinery Wastewaters by Fluoride Ion Chemical Ionization Mass Spectrometry,
W89-00209 5A

SOMVILLE, M.
Nitrogen Budget of the Scheldt Hydrographical Basin,
W89-00155 5B

SONDERGAARD, M.
Leaf Production and Nitrogen and Phosphorus Tissue Content of Littorella uniflora (L.) Aschers. in Relation to Nitrogen and Phosphorus Enrichment of the Sediment in Oligotrophic Lake Hampen, Denmark,
W89-00101 5C

SONZOGNI, W. C.
Evaluating the Modifications to the MF Total Coliform Method for Drinking Water with High Noncoliform Backgrounds,
W89-00427 5A

SORBER, C. A.
Look to the Future: Environmental Education,
W89-01121 5G

Microbial Characterization of Municipal Wastewater at a Spray Irrigation Site: the Lubbock Infection Surveillance Study,
W89-01124 7B

SORG, T. J.
Methods for Removing Uranium from Drinking Water,
W89-01110 5F

Operating a Small Full-Scale Ion Exchange System for Uranium Removal,
W89-01107 5F

SOROOSHIAN, S.
Maximum Likelihood Criterion for Use With Data Collected at Unequal Time Intervals,
W89-00723 2E

SOTIRIOU, N.
Ecological Parameter of Surface Water in Northeastern Greece,
W89-00564 5B

SOULSBY, P. G.
Role of Sewage Effluent in the Accumulation of Macroalgal Mats on Intertidal Mudflats in Two Basins in Southern England,
W89-00159 5C

SOUTHARD, J. B.
Experimental Study of Incipient Motion in Mixed-Sized Sediment,
W89-00721 2J

SOUTHERLAND, E.
Waste Allocation Simulation Models,
W89-01234 5D

SOVREA, D.
Viral Pollution of Surface Waters by Domestic Waste Water Discharge (Die Viral-Verunreinigung der Oberflachengewasser durch Ableiten der Haushaltsabwasser),
W89-00170 5B

SOWDEN, T. K.
Prediction of Rainbow Trout Embryo Survival in Relation to Groundwater Seepage and Particle Size of Spawning Substrates,
W89-00326 2H

SPAIN, J. C.
Biotic and Abiotic Degradation Rates of Methyl Parathion in Freshwater and Estuarine Water and Sediment Samples,
W89-00601 5B

SPEITEL, G. E.
Determination of Microbial Kinetic Coefficients through Measurement of Initial Rates by Radiochemical Techniques,
W89-01218 5D

SPENCE, D. H. N.
Growth Strategies and Distribution of Isoetids in Scottish Freshwater Lochs,
W89-00129 5C

SPENCER, C. P.
Use of Plant Micro-Nutrient and Chlorophyll Records as Indices of Eutrophication in Inshore Waters,
W89-00160 5A

SPENCER, M. J.
Trace Metal Geochemistry of Pore Water Brines from Two Hypersaline Lakes,
W89-01079 2K

SPIES, R. B.
Effects of Organic Contaminants on Reproduction of the Starry Flounder Platichthys stellatus in San Francisco Bay. I. Hepatic Contamination and Mixed-Function Oxidase (MFO) Activity During the Reproductive Season,
W89-00385 5C

SPRUILL, T. B.
Use of Total Organic Carbon as an Indicator of Contamination from an Oil Refinery, South-Central Kansas,
W89-00942 5A

SPURR, B. D.
Assessment of Flood Frequency Models Using Empirical Distribution Function Statistics,
W89-00976 2E

SPURRIER, J. D.
Exchange of Phosphorus between a Euhaline Vegetated Marsh and the Adjacent Tidal Creek,
W89-00283 5B

SPYRIDAKIS, D. E.
Lake Response Modeling Using Biologically Available Phosphorus,
W89-01236 5C

SRINIVASAN, M.
Mercury Pollution in the Estuarine Region around Bombay Island,
W89-00638 5B

STAHL, J. B.
Effect of pH and Total Ion Concentration on Growth Rate of Chironomus nr. maturus Larvae (Diptera: Chironomidae) from an Acid Strip-Mine Lake,
W89-00399 5C

STAHLE, D. W.
Texas Drought History Reconstructed and Analyzed from 1698 to 1980,
W89-00273 2B

STANDRIDGE, J. H.
Evaluating the Modifications to the MF Total Coliform Method for Drinking Water with High Noncoliform Backgrounds,
W89-00427 5A

STANIASZEK, P.
Chemistry and Delta 13C of Total Dissolved Carbon in Waters of Selected Springs Nearby Lublin City: Weekly Observations from October 1982 to June 1983,
W89-00895 2F

STARCK, B.
High Molar Mass Lignin in Bleached Kraft Pulp Mill Effluents,
W89-00361 5A

STAUFFER, R. E.
Sampling Strategies and Associated Errors in Estimating Epilimnetic Chlorophyll in Eutrophic Lakes,
W89-01242 2H

STAVES, R. P.
Chromium Removal from Water by Three Species of Duckweeds,
W89-00109 5D

STEDINGER, J. R.
Value of Stochastic Streamflow Models in Overyear Reservoir Design Applications,
W89-01244 2E

STEFAN, H. G.
Analysis of Turbulent Buoyant Jet in Density-Stratified Water,
W89-00491 5B

Mixing of Temperature-Stratified Lakes and Reservoirs by Buoyant Jets,
W89-00492 5G

STEFFAN, R. J.
Effects of Acidification on Mercury Methylation, Demethylation, and Volatilization in Sediments from an Acid-Susceptible Lake,
W89-00731 5B

STEICHEN, J.
Contamination of Farmstead Wells by Pesticides, Volatile Organics, and Inorganic Chemicals in Kansas,
W89-00946 5B

STEINBERG, C.
Intermittent Destratification: A Therapy Measure against Cyanobacteria in Lakes,
W89-00639 5G

Phytoplankton Studies of Slowly Running Waters: Rivers Danube and Vils (Phytoplanktonstudien an langamfliessenden Gewassern: Donau und Vils),
W89-00172 2E

STEWART, B. A.
Ecological Role of the Red-Knobbed Coot, Fulica cristata Gmelin, at the Bot River Estuary, South Africa: A Preliminary Investigation,
W89-00662 2L

STEWART, J. M.
Effects of Disturbances Along Hydroelectrical Transmission Corridors Through Peatlands in Northern Manitoba, Canada.
W89-00436 4C

STEWART, L. W.
Shallowly Placed, Low Pressure Distribution System to Treat Domestic Wastewater in Soils with Fluctuating High Water Tables,
W89-01171 5D

STICKLE, W. B.
Biochemical Composition of the Blue Crab Callinectes sapidus Exposed to the Water-Soluble Fraction of Crude Oil,
W89-00391 5C

STIEN, J. L.
Viability Determination of Ascaris Eggs Recovered from Waste-Water,
W89-00644 5A

STILLWATER, R.
Improved Methodology for a Collinear Dual-Energy Gamma Radiation System,
W89-00985 7B

STINNER, B. R.
Effects of Simulated Acidic Precipitation on Plant-Insect Interactions in Agricultural Systems: Corn and Black Cutworm Larvae,
W89-01160 5C

STINNER, D. H.
Effects of Simulated Acidic Precipitation on Plant-Insect Interactions in Agricultural Systems: Corn and Black Cutworm Larvae,
W89-01160 5C

STOBNICKE, J. B.
Water Supply Yields Power,
W89-01254 8C

STOKES, P. M.
Depressed Mercury Levels in Biota from Acid and Metal Stressed Lakes Near Sudbury, Ontario,
W89-00442 5B

STONE, A.
Assessing the Birkenes Model of Stream Acidification Using a Multisignal Calibration Methodology,
W89-00974 7B

STONE, G. W.
Hurricane-Related Morphodynamics and Implications for Hazard Mitigation, Perdido Key, Florida, U.S.A.,
W89-00291 6B

STONEMAN, G. L.
Effect of Logging and Regeneration on Groundwater, Streamflow and Stream Salinity in the Southern Forest of Western Australia,
W89-00350 4C

STORM, B.
Estimation of Catchment Rainfall Uncertainty and its Influence on Runoff Prediction,
W89-00892 2A

STOSS, F. W.
Comparison of Drinking Water Mutagenicity with Leaching of Polycyclic Aromatic Hydrocarbons from Water Distribution Pipes,
W89-00619 5C

STOW, D. A.
Sediment Delivery in a Semi-arid Coastal Stream,
W89-00346 2J

STRACK, O. D. L.
New Approximate Technique for the Hodograph Method in Groundwater Flow and Its Application to Coastal Aquifers,
W89-01243 2F

STRAMER, S. L.
Transport Modelling of Biological Tracers from Septic Systems,
W89-01226 5B

STRAPP, J. W.
Winter Cloud Water and Air Composition in Central Ontario,
W89-01265 5C

STRATMAN, S.
Rapid Specific Environmental Coliform Monitoring,
W89-00445 5A

STREBEL, P. M.
Legionnaire's Disease in a Johannesburg Teaching Hospital,
W89-00450 5F

STROMBERG, L. M.
Fate of Spent Bleach Liquor Material in Receiving Waters: Characterization of Chloroorganics in Sediments,
W89-00371 5B

STUBIN, A.
Sea-Surface Microlayer of Puget Sound: Part I: Toxic Effects on Fish Eggs and Larvae,
W89-00853 5C

STUKENBERG, J. R.
SDWA Amendments: Small Community Compliance,
W89-01112 6E

STUMM, W.
Binding of Heavy Metals to Algal Surfaces,
W89-01227 5B

Interpretation and Measurement of Redox Intensity in Natural Waters: A Comment to T. Frevert's Paper, 'Can the Redox Conditions in Natural Waters be Predicted by a Single Parameter',
W89-00689 2K

Role of Chemical Weathering in the Neutralization of Acidic Deposition,
W89-00696 5B

STUMP, M. M.
Selecting a Contract Operator for Your Water or Wastewater Facility,
W89-01100 5F

STURM, R.
Chlorinated Hydrocarbons in Sediments of the Elbe River and the Elbe Estuary,
W89-00614 5B

SUBRAMANIAN, V.
Sediment Transport of the Godavari River Basin and Its Controlling Factors,
W89-01211 2J

SUBRAMONIAN, S.
Evaluating Various Adsorbents and Membranes for Removing Radium from Groundwater,
W89-01109 5F

SUGAI, R.
Studies on Formations and Changes of Micro-Stratification in Blackish Water Lake Shinji, (in Japanese),
W89-00772 2H

SUGIMOTO, A.
Relationship Between delta-D and delta-18-O Values of Falling Snow Particles from a Separate Cloud,
W89-00406 2C

SUKHIJA, B. S.
Validity of the Environmental Chloride Method for Recharge Evaluation of Coastal Aquifers, India.
W89-00356 7B

SULAIMANOV, M. S.
New Life for Small Hydroelectric Stations in Kirgizia,
W89-00042 8C

SULLIVAN, M. J.
Water Column Productivity Attributable to Displaced Benthic Diatoms in Well-Mixed Shallow Estuaries,
W89-00297 2L

SUNDBACK, K.
Influence of Microphytobenthos on the Nutrient Flux between Sediment and Water: A Laboratory Study,
W89-01036 2L

SUNKAI, Y.
Determination of Trace Chromium in Natural Water by Polarographic Catalytic Wave Analysis, (in Chinese),
W89-00538 5A

SURFACE, S. W.
Development and Management of Groundwater Resources on Diego Garcia,
W89-00423 4B

SUTHERLAND, R. A.
Solute Sources and Transport in an Ephemeral Badland Catchment, Southeastern Alberta, Canada,
W89-00046 2J

SUZUKI, J.
Formation of 1-Nitropyrene by Photolysis of Pyrene in Water Containing Nitrite Ion,
W89-00586 5B

Photochemical Reaction of Biphenyl in Water Containing Nitrite or Nitrate Ion,
W89-00593 5B

SUZUKI, S.
Formation of 1-Nitropyrene by Photolysis of Pyrene in Water Containing Nitrite Ion,
W89-00586 5B

Photochemical Reaction of Biphenyl in Water Containing Nitrite or Nitrate Ion,
W89-00593 5B

SWAMEE, P. K.
Generalized Rectangular Weir Equations,
W89-00905 8B

SWANK, W. T.
Effects of Leaching and Whole-Tree Harvesting on Cation Budgets of Several Forests,
W89-01166 4C

SWIATECKI, A.
Simple Self-Acting Hydrobiological Sampler (Prosty samoczynny czerpacz hydrobiologiczny),
W89-00033 7B

SWINDOLL, C. M.
Aerobic Biodegradation of Natural and Xenobiotic Organic Compounds By Subsurface Microbial Communities,
W89-01090 5B

SYKES, R. G.
New Regulations: A Challenge for Small Systems,
W89-01118 5F

SYMONS, B. D.
Fate and Transport of Organics in Soil: Model Predictions and Experimental Results,
W89-01239 5B

SYVITSKI, J. P.
Basin Sedimentation and the Growth of Prograding Deltas,
W89-00832 2J

SZLAUER, B.
Testing the Secondary Treatment of Effluents from the 'Police' Chemical Plant in Carp Ponds,
W89-00255 5D

SZLAUER, L.
Testing the Secondary Treatment of Effluents from the 'Police' Chemical Plant in Carp Ponds,
W89-00255 5D

SZMEJA, J.
Seasonal Development of Lobelia Dortmanna L. and Annual Balance of Its Population Size in an Oligotrophic Lake,
W89-00526 2H

Structure of a Population of Lobelia dortmanna L. Along a Gradient of Increasing Depth in an Oligotrophic Lake,
W89-00525 2H

SZTRANTOWICZ, H.
Indicatory Role of Some Invertebrates for Quality of Water in the Vistula River and in Subsequent Stages of Its Treatment,
W89-00236 5A

SZYSZKA, T.
Concentrations of Nitrogen and Phosphorus in Waters of Two Hypertrophic Lakes and Their Effect on the Quantity of Phytoplankton Biomass,
W89-00245 2H

TACONET, O.
Estimation of Bare Soil Evaporation from Airborne Measurements,
W89-00352 7B

TAHA, Z.
Indirect Trace Determination of Ethylenediaminetetraacetic Acid (EDTA) in Water by Potentiometric Stripping Analysis,
W89-00481 5A

TAKAMURA, N.
Sedimentation of Phytoplankton Populations Dominated by Microcystis in a Shallow Lake,
W89-00233 2H

TAKAYAMA, K.
Monitoring of PCDDs in Osaka Bay Using Blue Mussel,
W89-00604 5B

TALBOT, M. M. B.
Spatial Patterns of N Fixation (Acetylene Reduction) along Environmental Gradients in a Warm-Temperate Estuary,
W89-00475 2L

TALWALKER, R. K.
Rating System for a Utility Rehabilitation Program,
W89-00467 6A

TAMM, C. O.
Changes in Soil Acidity in Two Forest Areas with Different Acid Deposition: 1920s to 1980s,
W89-00444 5B

TAMURA, T.
Adsorption of Indigo Carmine by Activated Carbon,
W89-00633 5D

TAN, G. S.
Solubilities of Trace Copper and Lead Species and the Complexing Capacity of River Water in the Linggi River Basin,
W89-00084 5B

TAN, W. T.
Solubilities of Trace Copper and Lead Species and the Complexing Capacity of River Water in the Linggi River Basin,
W89-00084 5B

TANA, J. J.
Sublethal Effects of Chlorinated Phenols and Resin Acids on Rainbow Trout (Salmo gairdneri),
W89-00364 5C

TANADA, S.
Adsorption of Indigo Carmine by Activated Carbon,
W89-00633 5D

TANNER, D. K.
Acute and Chronic Toxicity of Triphenyltin Hydroxide to Fathead Minnows (Pimephales promelas) Following Brief or Continuous Exposure,
W89-01057 5C

TARBOTON, D. G.
Fractal Nature of River Networks,
W89-00975 2E

TARDENT, P.
Dynamics of Hydra Populations in Lake Zurich, Switzerland, and Lake Maggiore, Italy,
W89-00692 2H

TARDENT, R.
Dynamics of Hydra Populations in Lake Zurich, Switzerland, and Lake Maggiore, Italy,
W89-00692 2H

TARLOCK, A. D.
Changing Meaning of Water Conservation in the West,
W89-01269 6E

TARTERA, C.
Relationship between Numbers of Enteroviruses and Bacteriophages Infecting Bacteroides fragilis in Different Environmental Samples,
W89-00645 5A

TATSUKAWA, R.
Polybrominated Biphenyl Ethers in Marine Fish, Shellfish, and River and Marine Sediments in Japan,
W89-00610 5B

TAWARI, P.
Rotifers of Warri River, Nigeria,
W89-00222 2H

TAWN, J. A.
Extreme-Value Theory Model for Dependent Observations,
W89-01208 7C

TAYLOR, C. W. P.
Petaling Jaya Non-Revenue Water Control Project Selangor, Malaysia,
W89-00923 5F

TAYLOR, R.
Factors Forming the Level and Dynamics of Nutrient Runoff from an Agricultural Watershed,
W89-00261 5B

TAYLOR, T. W.
Screened Auger Sampling: The Technique and Two Case Studies,
W89-00945 5A

TEAL, J. M.
Biogeochemistry of Benz(a)anthracene at the Sediment-Water Interface,
W89-00612 5B

TECLAFF, E.
International Control of Cross-Media Pollution: An Ecosystem Approach,
W89-00520 5G

TECLAFF, L. A.
International Control of Cross-Media Pollution: An Ecosystem Approach,
W89-00520 5G

TECLE, A.
Multicriterion Selection of Wastewater Management Alternatives,
W89-00300 5D

TEMPLETON, L. L.
Effect of Culture History on the Determination of Biodegradation Kinetics by Batch and Fed-Batch Techniques,
W89-00513 5D

TESSENDORFF, H.
Water Catchment Installations Harmonized with Ecological Aspects - An Example in Berlin (West),
W89-00926 6B

TETEL'MIN, V. V.
Components of Forces of a Reservoir Acting on the Foundation of High Dams,
W89-00073 8B

TETT, P.
Phytoplankton Ecology of the Firth of Clyde Sea-Lochs Striven and Fyne,
W89-00813 2L

TEWARI, H.
Branchial and Renal Pathology in the Fish Exposed Chronically to Methoxy Ethyl Mercuric Chloride,
W89-01156 5C

THACKSTON, E. L.
Flocculent Settling above Zone Settling Interface,
W89-00484 5E

THADANI, V. J.
Effects of Biofilter Media on the Performance of Anaerobic Hybrid Reactors,
W89-00626 5D

THALKEN, C. E.
Long-term Study of Ecosystem Contamination with 2,3,7,8-Tetrachlorodibenzo-p-dioxin,
W89-00603 5B

THIEM, L. T.
In situ Adapation of Activated Sludge by Shock Loading to Enhance Treatment of High Ammonia Content Petrochemical Wastewater,
W89-01127 5D

THOMAS, A. C.
Tidal Transport of Planktonic Copepods across the Sill of a British Columbia Fjord,
W89-00221 2L

THOMAS, J. M.
Sensitivity of Four Monitoring Well Sampling Systems to Low Concentration of Three Volatile Organics,
W89-00944 5A

THOMAS, P. A.
Nitrogen, Phosphorus and Potassium in Salvinia molesta Mitchell in the Field: Effects of Weather, Insect Damage, Fertilizers and Age,
W89-00113 2H

THOMPSON, D. B. A.
Patterns of Association Between Birds and Invertebrates in the Clyde Estuary,
W89-00811 2L

THORNE, S. C.
Changes in the Fish Fauna of the Bot River Estuary in Relation to Opening and Closure of the Estuary Mouth,
W89-00665 2L

THRAILKILL, J.
Drawdown Interval Analysis: A Method of Determining the Parameters of Shallow Conduit Flow Carbonate Aquifers from Pumping Tests,
W89-00986 2F

THURMAN, R. B.
Characterization of the Interaction Between Viruses and a Solid Polymeric Contact Disinfectant,
W89-00884 5F

THURSTON, R. V.
Acute Toxicity of Thiocyanate to Trout,
W89-00330 5C

TIBBETS, P. J. C.
Degradation of Low-Toxicity Oil-Based Drilling Mud in Benthic Sediments around the Beatrice Oilfield,
W89-00792 5B

Hydrocarbons in Nigg Bay Sediments,
W89-00790 5B

TIEDEMANN, A. R.
Bacterial Water Quality Responses to Four Grazing Strategies: Comparisons with Oregon Standards,
W89-01170 5B

TILBROOK, P. J.
Nature Conservation in the Moray Firth,
W89-00776 2L

TILLE-BACKHAUS, R.
Phytoplankton Studies of Slowly Running Waters: Rivers Danube and Vils (Phytoplanktonstudien an langamfliessenden Gewassern: Donau und Vils),
W89-00172 2E

TILZER, M. M.
Bacterial Response to Seasonal Changes in Primary Production and Phytoplankton Biomass in Lake Constance,
W89-00225 2H

Quantum Yield as a Fundamental Parameter Controlling Vertical Photosynthetic Profiles of Phytoplankton in Lake Constance,
W89-00176 2H

Seasonal Productivity Cycle of Phytoplankton and Controlling Factors in Lake Constance,
W89-00022 2H

TINGJIAN, W.
Application of the Principle of Least Sigma to the Chemical Model of Natural Water, (in Chinese),
W89-00537 2H

TITTLEBAUM, M.
Effects of Three Organics on Selected Physical Properties of Type I Portland Cement,
W89-00994 5E

TITTLEBAUM, M. E.
Transmission Electron Microscopic Study of Solidified/Stabilized Organics,
W89-01000 5E

TIVY, J.
Geography of the Estuary and Firth of Clyde,
W89-00798 2L

TOBIANSKY, L.
Legionnaire's Disease in a Johannesburg Teaching Hospital,
W89-00450 5F

TODINI, E.
Rainfall-Runoff Modeling: Past, Present and Future,
W89-01023 2A

TOFT, G.
Planning Indiana's Water Infrastructure from a Competitive Perspective,
W89-00880 6B

TOKOMBAEV, K. A.
Small Hydroelectric Stations and Prospects of Their Development,
W89-00059 8C

TOKOS, J. J.
Local Influences on the Composition of Precipitation on Bermuda,
W89-00405 2A

TOMASZEWICZ, H.
Differentiation of the Physical and Chemical Properties of Bottom Sediments in Phytocenoses of Myriophylletum verticillati Soo 1927, Potamogetonetum natantis Soo 1927 and Hydrocharitetum morsus-ranae Langendonck 1935 Associations,
W89-00259 2H

TONGZHAO, C.
Probing into the Computation Method on Sedimentary Amount of Poyang Lake, (in Chinese),
W89-00540 2H

TOPP, G. C.
Determination of Electrical Conductivity Using Time Domain Reflectometry: Soil and Water Experiments in Coaxial Lines,
W89-00702 2G

Multiple Reflection and Attenuation of Time Domain Reflectometry Pulses: Theoretical Considerations of Applications to Soil and Water,
W89-00701 7B

TOSINE, H. M.
Emissions of Chlorinated Organics from a Municipal Sewage Sludge Burning Incinerator,
W89-00607 5B

TOSO, J. W.
Extreme Pressures in Hydraulic-Jump Stilling Basins,
W89-00896 8B

TOSTE, A. P.
Sensitivity of Four Monitoring Well Sampling Systems to Low Concentration of Three Volatile Organics,
W89-00944 5A

TOTH, L. G.
Role of Storms in the Summer Succession of the Phytoplankton Community in a Shallow Lake (Lake Balaton, Hungary),
W89-00232 2H

TOUSSI, S.
Dempster's Rule of Combination in Soil-Loss Prediction,
W89-00303 2J

TOWNSEND, C.
Fish, Fleas and Phytoplankton,
W89-00851 5C

TOWNSON, J. M.
Water Movement and the Simulation of Storm Surges in the Firth of Clyde,
W89-00803 2L

TRAINA, S. J.
Properties of Water Treatment Lime Sludges and Their Effectiveness as Agricultural Limestone Substitutes,
W89-00516 5F

TRANVIK, L.
Microbial Degradation of Xenobiotic, Aromatic Pollutants in Humic Water,
W89-00344 5B

TRAVERSO, P. G.
Comparison of Co-Digestion Performance of Two Differently Collected Organic Fractions of Municipal Solid Waste with Sewage Sludges,
W89-00643 5D

TRELA, K.
Development of Microorganisms on the Background of Organic Matter in Forest Ecosystem Waters,
W89-00080 2H

TRIFUNAC, M. D.
Transient Pressures in Hydrotechnical Tunnels During Earthquakes,
W89-00448 8E

TRIPATHI, G.
Toxicity Bioassay of Technical and Commercial Formulations of Carbaryl to the Freshwater Catfish, Clarias batrachus,
W89-00086 5C

TRIPP, B. W.
Biogeochemistry of Benz(a)anthracene at the Sediment-Water Interface,
W89-00612 5B

TROITSKII, A. P.
Estimation of the Reliability of Earth Dams with Consideration of Seismic Loads,
W89-00557 8E

TROJANOWSKA, C.
Chemical Characteristics of Bottom Sediment Top Layer in Szczytno Male Lake,
W89-00237 2H

Chlorophyll Relationships in Letowo and Szczytno Male Lakes, with Trout Cage Culture,
W89-00262 2H

Hydrochemical Study of Lake Szczytno Male With Trout Cage Culture,
W89-00241 5B

Primary Production in Lakes with Cage Trout Culture,
W89-00238 2H

TROJANOWSKI, J.
Chemical Characteristics of Bottom Sediment Top Layer in Szczytno Male Lake,
W89-00237 2H

Chlorophyll Relationships in Letowo and Szczytno Male Lakes, with Trout Cage Culture,
W89-00262 2H

Hydrochemical Study of Lake Szczytno Male With Trout Cage Culture,
W89-00241 5B

Nitrogen and Phosphorus Balance in Lake Szczytno Male,
W89-00240 2H

Primary Production in Lakes with Cage Trout Culture,
W89-00238 2H

Sorption Properties of Bottom Sediments of Szczytno Male and Letowo Lakes,
W89-00256 2H

TROUTMAN, B. M.
Regression Estimates for Topological-Hydrograph Input,
W89-00304 2E

TRUDEL, M.
Wound Fiberglass Depth Filters as a Less Expensive Approach for the Concentration of Viruses from Water,
W89-00279 5A

TRUDGILL, S. T.
Stream Nitrate Levels in a Small Catchment in South West England Over a Period of 15 Years (1970 - 1985),
W89-00915 5B

TRZILOVA, B.
Bacterial Degradation of Crude Oil Water Pollutants in Danube Water (Die bakterielle Degradation von Erdolkohlenwasserstoffen im Donauwasser),
W89-00168 5B

TSAY, T.-K.
Alternative Strategies for Stormwater Detention,
W89-00875 4A

TSCHUDY, K. L.
Liquid Cloudwater Collection Using Modified Mohnen Slotted Rods,
W89-00764 7B

TSIHRINTZIS, V. A.
Scour Channel Development after Spillway Failure,
W89-00897 2J

TSITOURIDOU, R.
Boron Levels in Some Ground Waters of Halkidiki (A Land at Northern Aegean Sea),
W89-00569 5B

TSUTSUMI, Y.
Chloropicrin in Potable Water: Conditions of Formation and Production during Treatment Processes (La Chloropicrine dans les Eaux Potables: Conditions de Formation et Evolution le long des Filieres de Traitement),
W89-00635 5F

TSVIRIN'KO, O. S.
Water-Management Significance of the Moscow Canal,
W89-00050 3B

TUFAIL, A.
Bioturbation, Microbial Activity and Sediment Properties in an Estuarine Ecosystem,
W89-00806 2L

TUNDISI, J. G.
Vertical Distribution of Phytoplankton in a Stratified Lake (Lago Dom Helvecio, Southeastern Brazil) with Special Reference to the Metalimnion,
W89-00768 2H

TURGEON, A.
Application of Principal Component Analysis to Long-Term Reservoir Management,
W89-00698 6A

TURK, C. A.
Microbial Characterization of Municipal Wastewater at a Spray Irrigation Site: the Lubbock Infection Surveillance Study,
W89-01124 7B

TURK, V.
Bacteriological Contamination of the Eastern Part of the Gulf of Trieste (North Adriatic) Due to Sewage Discharge,
W89-00577 5B

TURNBULL, R. G. H.
Coastal Planning in the Moray Firth,
W89-00777 2L

TURNER, M. A.
Disruption of the Nitrogen Cycle in Acidified Lakes,
W89-00451 5C

TURNER, R. E.
Marsh Management Plans in Practice: Do They Work in Coastal Louisiana, USA,
W89-01060 2L

TURTON, E.
Persistent Effects of Cloud Seeding with Silver Iodide,
W89-00091 3B

TUTUNJI, M.
Indirect Trace Determination of Ethylenediaminetetraacetic Acid (EDTA) in Water by Potentiometric Stripping Analysis,
W89-00481 5A

TWILLEY, R. R.
Biomass Production and Nutrient Cycling in Aquatic Macrophyte Communities of the Chowan River, North Carolina,
W89-00097 2H

TYAGI, N. K.
Improving Canal Water Deliveries with Auxiliary Storage,
W89-00758 3B

UCHRIN, C. G.
Basic Encoded Model for One-Dimensional Ground Water Systems Incorporating First-Order Degradation Kinetics,
W89-00888 5B

UDELL, K. S.
Nonaqueous Phase Liquid Transport and Cleanup: I. Analysis of Mechanisms,
W89-00968 5B

Nonaqueous Phase Liquid Transport and Cleanup: II. Experimental Studies,
W89-00969 5B

UDLUFT, P.
Hydrogeological and Hydrogeochemical studies of the Unsaturated Flow in a Gravel Aquifer: Part II. Results of Long Term Soil-hydrological Measurements (Hydrogeologische und Hydrochemische Untersuchungen in der Ungesaettigten Zone eines Kiesgrundwasserleiters: Teil II. Ergebnisse Langjaehriger Bodenhydrologischer Messungen),
W89-00503 2F

UEDA, T.
Mechanism of Inactivation of Tobacco Mosaic Virus with Ozone,
W89-01229 5F

ULLSPERGER, I.
Hydrogeological and Hydrogeochemical studies of the Unsaturated Flow in a Gravel Aquifer: Part II. Results of Long Term Soil-hydrological Measurements (Hydrogeologische und Hydrochemische Untersuchungen in der Ungesaettigten Zone eines Kiesgrundwasserleiters: Teil II. Ergebnisse Langjaehriger Bodenhydrologischer Messungen),
W89-00503 2F

ULYASHINSKII, V. A.
Experience in Operating Hydraulic Structures and Equipment of Hydroelectric Stations,
W89-00554 8C

URBAN, J. B.
Chemical-Hydrologic Interactions in the Near-Stream Zone,
W89-00717 2E

USPENSKII, B. S.
Power Facilities of the Moscow Canal,
W89-00053 8C

VAISHNAV, D. D.
Comparison of Chemical Biodegradation Rates in BOD Dilution and Natural Waters,
W89-01158 5B

VALENTIJN, P.
Distribution, Dynamics and Productivity of a Colonizing (Polydora quadrilobata) and an Established (P. ligni) Polydorid Polychaete in Lake Grevelingen: An Enclosed Estuary in the SW Netherlands,
W89-00002 2H

VALLINI, G.
Comparison of Co-Digestion Performance of Two Differently Collected Organic Fractions of Municipal Solid Waste with Sewage Sludges,
W89-00643 5D

VALOCCHI, A. J.
Theoretical Analysis of Deviations from Local Equilibrium During Sorbing Solute Transport Through Idealized Stratified Aquifers,
W89-00987 5B

VAN BAKEL, P. J. T.
Modelling Soil Water Dynamics in the Unsaturated Zone: State of the Art,
W89-01014 2G

VAN DER KAMP, G.
Hydrogeology of Two Saskatchewan Tills. I. Fractures, Bulk Permeability, and Spatial Variability of Downward Flow,
W89-01201 2F

Hydrogeology of Two Saskatchewan Tills. II. Occurrence of Sulfate and Implications for Soil Salinity,
W89-01202 2F

VAN DER MOLEN, W. H.
Transport of Solutes in Soils and Aquifers,
W89-01027 5B

VAN DER VALK, A. G.
Seed Germination Traits of Annuals and Emergents Recruited during Drawdowns in the Delta Marsh, Manitoba, Canada,
W89-00126 2H

VAN DER VEEN, C.
Central Softening by Crystallization in a Fluidized-Bed Process,
W89-00421 5F

VAN DER VEER, H. W.
Dredging Activities in the Dutch Wadden Sea: Effects on Macrobenthic Infauna,
W89-00151 2L

VAN DYKE, G. D.
Distribution of Chitinolytic Bacteria in Various Aquatic Systems: A Comparative Study,
W89-00402 2H

VAN FOREEST, D.
Numerical Model for the Wind-Driven Circulation in the Bot River Estuary,
W89-00652 2L

VAN GELDERMALSEN, L. A.
Evaluation of Seasonal Nutrient Dynamics in the Oosterschelde (SW Netherlands),
W89-00153 2L

VAN HEERDEN, I.
Barrier/Estuarine Processes. Bot River Estuary: An Interpretation of Aerial Photographs,
W89-00650 2L

VAN HEERDEN, I. L.
Fluvial Sedimentation in the Ebb-Dominated Orange Estuary,
W89-00456 2J

VAN LEEUWEN, J.
Bulking Control with Ozonation in a Nutrient Removal Activated Sludge System,
W89-00930 5D

VAN MIEGROET, H.
Effects of Leaching and Whole-Tree Harvesting on Cation Budgets of Several Forests,
W89-01166 4C

VAN OMMEN, H. C.
Transport of Solutes in Soils and Aquifers,
W89-01027 5B

VAN REENEN, A. J.
Formation of Hydrous Zirconium (IV) Oxide Polyelectrolyte Membranes, I. Poly (itaconic acid) and Poly (acrylic-co-itaconic acid),
W89-01062 3A

VAN SCHAYCK, C. P.
Effect of Several Methods of Aquatic Plant Control on Two Bilharzia-Bearing Snail Species,
W89-00117 4A

VAN STADEN, J. F.
Determination of Phosphate at Low Concentrations in Surface Waters by Flow-Injection Analysis,
W89-00931 5A

VAN VLIET, H. R.
Determination of Phosphate at Low Concentrations in Surface Waters by Flow-Injection Analysis,
W89-00931 5A

VAN WINKLE, W.
Potential Importance of Spatial and Temporal Heterogeneity in pH, Al, and Ca in Allowing Survival of a Fish Population: A Model Demonstration,
W89-01052 5C

VANBRAMER, S.
Liquid Cloudwater Collection Using Modified Mohnen Slotted Rods,
W89-00764 7B

VANDEKREEKE, J.
Experimental Determination of Salt Intrusion Mechanisms in the Volkerak Estuary,
W89-00667 2L

VANLIERE, J. M.
Partitioning of Organochlorines Between Water, Particulate Matter and Some Organisms in Estuarine and Marine Systems of the Netherlands,
W89-00672 5B

VARDIA, H. K.
Pesticidal Effects on Chironomid Larvae,
W89-00079 5C

VARTIAINEN, T.
Effect of Permanganate Oxidation and Chlorination on the Mutagenic Activity and other Quality Parameters of Artificially Recharged Ground Water Processed from Humus-rich Surface Water,
W89-00599 5F

VASUDEVAN, T. V.
Novel Approach for Modifying Microporous Filters for Virus Concentration from Water,
W89-00332 5A

VELANISHKIS, I. M.
Technology of Casting Precast Pipeline Elements of the Kaisiadory's Pumped-Storage Station,
W89-00045 8F

VELDHUIS, M. J. W.
Availability of Phosphorus Sources for Blooms of Phaeocystis pouchetii (Haptophyceae) in the North Sea: Impact of the River Rhine,
W89-00004 2L

VELTHORST, N. H.
Determination of Polychlorinated Dibenzofurans in Surface Water by Means of Liquid Chromatography Using on-Line Sample Preconcentration and Different Spectroscopic Detection Techniques,
W89-00590 5A

VELTRI, M.
Friction Factor Evaluation in Gravel-Bed Rivers,
W89-00898 8B

VENEKAMP, L. A. H.
Availability of Phosphorus Sources for Blooms of Phaeocystis pouchetii (Haptophyceae) in the North Sea: Impact of the River Rhine,
W89-00004 2L

VENKATRAM, A.
Testing a Comprehensive Acid Deposition Model,
W89-00310 5B

VERGIN, N. N.
Concerning Certain Studies on Seepage and Dissolution of Salts in the Foundation of Dams,
W89-00062 10C

VERHAGEN, J. H. G.
Modelling Research on the Production Cycle of Phytoplankton in the Southern Bight of the North Sea in Relation to Riverborne Nutrient Loads,
W89-00157 2L

VERHOEVEN, J. T. A.
Nutrient Dynamics in Minerotrophic Peat Mires,
W89-00119 2H

VERNON, K. R.
Future Prospects for Hydro Electricity and Windpower,
W89-00793 6C

VESILIND, P. A.
Movement of Sludge through Conveyor Centrifuge,
W89-00485 5D

VEZINA, A. F.
Body Size and Mass Flow in Freshwater Plankton: Models and Tests,
W89-00218 2H

VICTORIA, R. L.
Contribution of Spartina alterniflora to the Pedra de Guaratiba (RJ) Salt Marsh Sediment Using Carbon-13 as a Tracer (Contribuicao de Materia Organica de Spartina alterniflora Para o Sedimento do Alagado de Pedra de Guaratiba (RJ): Uso de C13 como Tracador),
W89-00010 2L

VIDAL-MADJAR, D.
Estimation of Bare Soil Evaporation from Airborne Measurements,
W89-00352 7B

VIESSMAN, W.
Technology, Institutions, and Social Goals,
W89-00871 6D

VIGNESWARAN, S.
Empirical Correlation for Estimating Pressure Drop Across Clogged Filters,
W89-00924 5F

VIJJESWARAPU, W.
Evaluating Various Adsorbents and Membranes for Removing Radium from Groundwater,
W89-01109 5F

VIKTOR, T.
Environmental Fate of Chloroguaiacols and Chlorocatechols,
W89-00369 5B

VIL'VOVSKII, V. V.
Automation of Conveyor Transport at the Construction Site of Earth Dams,
W89-01173 8H

VIRE, J.-C.
Determination of Cobalt Ions in Natural Waters Using Differential Pulse Adsorptive Stripping Voltammetry,
W89-00480 5A

VIRNSTEIN, R. W.
Seasonal Abundance and Distribution of Drift Algae and Seagrasses in the Mid-Indian River Lagoon, Florida,
W89-00104 2L

VLASENKO, V. N.
Experience in Determining the Numerical Characteristics of Landslide Movements,
W89-00551 8A

VOGEL, J.
Contamination of Surface Sediments of the Principal Rivers of Geneva Canton by Polychlorinated Biphenyls and DDT (Contamination des Sediments Superficiels des Principales Rivieres du Canton de Geneve par les Polychlorobiphenyles et DDT),
W89-00690 5B

VOGEL, R. M.
Value of Stochastic Streamflow Models in Overyear Reservoir Design Applications,
W89-01244 2E

VOLKENING, J.
Determination of Heavy Metals at the Pg/g Level in Antarctic Snow with DPASV and IDMS,
W89-00270 5A

VOLLENWEIDER, R. A.
Scientific Concepts and Methodologies Pertinent to Lake Research and Lake Restoration,
W89-00013 2H

VOLOVIK, S. P.
Changes in the Ecosystem of the Azov Sea in Relation to Economic Development in the Basin,
W89-01192 6G

VON GUNTEN, H. R.
Reactor Accident at Chernobyl: A Possibility to Test Colloid-Controlled Transport of Radionuclides in a Shallow Aquifer,
W89-00990 5B

VON WESTERNHAGEN, H.
Toxicity of Sea-Surface Microlayer: Effects of Hexane Extract on Baltic Herring (Clupea harengus) and Atlantic Cod (Gadus morhua) Embryos,
W89-00856 5C

Toxicity of Sea-Surface Microlayer: Effects On Herring and Turbot Embryos,
W89-00855 5C

VONDRACEK, B.
Influence of Temperature on Microhabitat Choice by Fishes in a California Stream,
W89-00027 2H

VONG, R. J.
Changes in Rainwater Acidity Associated with Closure of a Copper Smelter,
W89-00272 5B

VOULGAROPOULOS, A.
Correlation of Some Organic Pollution Factors in Water Systems in Northern Greece,
W89-00566 5B

VOWLES, P. D.
Sediment-Water Partition Coefficients and HPLC Retention Factors of Aromatic Hydrocarbons,
W89-00560 5B

VRAITSEV, V. V.
Ultrasonic Flowmeter for Testing Units of Large Hydroelectric and Pumped-Storage Stations,
W89-01181 8C

VUGTS, H. F.
Heat Balance of a Tidal Flat Area,
W89-00148 2L

WABER, U. E.
Reactor Accident at Chernobyl: A Possibility to Test Colloid-Controlled Transport of Radionuclides in a Shallow Aquifer,
W89-00990 5B

WACHS, B.
Structure of Macrobenthic Biomass in the Gravel Bed of the Pre-Alpine Loisach River (Die Struktur der makrobenthischen Biomasse in einem voralpinen Schotterbett am Beispiel der mittleren Loisach),
W89-00167 2H

WAGENET, R. J.
Sorption and Degradation of Aldicarb and Its Oxidation Products in a Soil-Water Flow System as a Function of pH and Temperature,
W89-01164 5B

WAHAAB, R.SH. A.
Treatability Studies of Textile Wastewater,
W89-00627 5D

WAHLEN, M.
Sedimentation of 74 PCB Congeners in the Upper Hudson River,
W89-00584 5B

WAJON, J. E.
Controlling Swampy Odors in Drinking Water,
W89-00425 5F

WALDVOGEL, A.
Aerosol and Hydrometeor Concentrations and Their Chemical Composition during Winter Precipitation along a Mountain Slope: I. Temporal Evolution of the Aerosol, Microphysical and Meteorological Conditions,
W89-01150 2B

WALKER, D. I.
Correlations between Salinity and Growth of the Seagrass Amphibolis antarctica (Labill.) Sonder & Aschers., in Shark Bay, Western Australia, Using a New Method for Measuring Production Rate,
W89-00102 2L

WALKER, W. W.
Biotic and Abiotic Degradation Rates of Methyl Parathion in Freshwater and Estuarine Water and Sediment Samples,
W89-00601 5B

WALLACE, G. G.
Instrumentation for 7-Day Continuous Cycle Monitoring of Metals with Automated On-Line Sample Preparation, High-Performance Liquid Chromatography, and Electrochemical Detection,
W89-00210 5A

WALLING, D. E.
Erosion and Sediment Yield Research: Some Recent Perspectives,
W89-01015 2J

Landsat-MSS Radiance as a Measure of Suspended Sediment in the Lower Yellow River (Hwang Ho),
W89-00065 7B

Stream Nitrate Levels in a Small Catchment in South West England Over a Period of 15 Years (1970 - 1985),
W89-00915 5B

WALSH, M.
Biology and Management of Herring and Other Pelagic Fish Stocks in the Firth of Clyde,
W89-00825 2L

WALSH, M. E.
Evaluation of Disposable Membrane Filter Units for Sorptive Losses and Sample Contamination,
W89-00623 5A

WAMPLER, T. P.
Purge and Trap Analysis of Aqueous Samples with Cryofocusing,
W89-00446 5A

WANG, F. C.
Dynamics of Saltwater Intrusion in Coastal Channels,
W89-00833 2L

WANG, S. Y.
Biochemical Composition of the Blue Crab Callinectes sapidus Exposed to the Water-Soluble Fraction of Crude Oil,
W89-00391 5C

WANG, Z. J.
Interpretation of Metal Profiles in a Sediment Core from Lake Geneva: Metal Mobility or Pollution,
W89-00694 5B

WARD, C. G.
Effect of Logging and Regeneration on Groundwater, Streamflow and Stream Salinity in the Southern Forest of Western Australia,
W89-00350 4C

WARD, D. M.
Photoexcretion and Fate of Glycolate in a Hot Spring Cyanobacterial Mat,
W89-00342 2H

WARNAKA, K.
Analyses of Equations for Free Water Evaporation Estimates,
W89-00705 2D

WARREN, C. E.
Utility of Laboratory Streams for Ecosystem Toxicity Studies,
W89-01059 5B

WASHALL, J. W.
Purge and Trap Analysis of Aqueous Samples with Cryofocusing,
W89-00446 5A

WASSMANN, P.
Sedimentation of Particulate Material in Two Shallow, Land-Locked Fjords in Western Norway,
W89-01008 2J

WATANABE, I.
Polybrominated Biphenyl Ethers in Marine Fish, Shellfish, and River and Marine Sediments in Japan,
W89-00610 5B

WATANABE, K.
Continuous-flow System for the Determination of Cobalt in Sea and River Water: In-line Preconcentration/Separation Coupled with Catalytic Determination,
W89-00063 5A

WATSON, J.
Long-Term Changes in Some Benthic Species in the Firth of Clyde, with Particular Reference to Tellina tenuis da Costa,
W89-00817 5C

WATSON, P. G.
Comparison of Nutrients in the Interstitial Water of Reducing (Tamar Estuary) and Oxic (Carmarthen Bay) Coastal Sediments,
W89-00156 2L

WATTERS, G.
Water Supply and Sanitation - Cornerstones of the World Health Organization's Forty Years of International Health Development,
W89-00917 5F

WATTS, F. J.
Explicit Solution to Green-Ampt Equation for Nonuniform Soils,
W89-00760 7B

WEBER, M. F.
Effect of pH and Contact Time on the Concentration of As(III) and As(V) in Coal Ash Systems,
W89-00624 5E

WEBER, W. J.
Estimating Soil/Sediment Partition Coefficients for Organic Compounds by High Performance Reverse Phase Liquid Chromatography,
W89-01223 5B

Ozone-Induced Particle Destabilization,
W89-01120 5F

WEBSTER, J.
Epilithic Diatoms of the Clyde Estuary,
W89-00808 2L

WEBSTER, T. J.
Microporous Filters with Oxidizing Power for Iron and Manganese Removal from Water,
W89-00889 5F

WEI, L.
Primary Studies on Population Dynamics of 3 Species of Cladocera (Waterflea) in Dianshan Lake, (in Chinese),
W89-00198 2H

WEIDEMANN, H.
Studies of the Oxidative Photoinduced Degradation of Silicones in the Aquatic Environment,
W89-00617 5B

WEIGMANN, D. L.
Pesticides: A Continuing Dilemma,
W89-01122 5B

WEILER, R. R.
Data Analysis of Water Quality Time Series in Lake Erie,
W89-00866 7C

WEILL, A.
Estimation of Bare Soil Evaporation from Airborne Measurements,
W89-00352 7B

WEIN, R. W.
Experimental Studies on the Resiliency of Floating Typha Mats in a Freshwater Marsh,
W89-00287 2H

WEINHEIMER, A. J.
Charge Induced on a Conducting Cylinder by a Point Charge and Its Application to the Measurement of Charge on Precipitation,
W89-00762 7B

WEINMAN, J. A.
Determining Microwave Brightness Temperatures from Precipitating Horizontally Finite and Vertically Structured Clouds,
W89-01263 7B

WEISE, G.
Oxygen Budget of a River in Submerged Macrophytes (River Zschopau in the South of the GDR),
W89-00137 2H

WEISER, A.
Formation of Oxygen Species and Their Reactions with Organic Chemicals in Aqueous Solution,
W89-00575 5B

WELCH, E. B.
Lake Response Modeling Using Biologically Available Phosphorus,
W89-01236 5C

WELLERSHAUS, S.
River Ems: Processes Affecting the Behaviour of Metals and Organochlorines during Estuarine Mixing,
W89-00149 5B

WELLS, S. A.
Compressible Cake Filtration: Monitoring Cake Formation and Shrinkage Using Synchrotron X-rays,
W89-00512 5D

WENDA, C.
Studies on Marine Humic Substances: III. The Distribution of Humic Substances in Seawater and Sediments in the Estuary of Changjiang River and East China Sea, (in Chinese),
W89-00541 2L

Studies on Marine Humic Substances: IV. The Distribution of Humic Substances in the Seawater and Sediments of Huanghe River Estuary, (in Chinese),
W89-00545 2L

WENDT, R. H.
Nitrilotriacetic Acid (NTA) Environmental Monitoring Program in Indiana: 1979 to 1983,
W89-01089 5A

WENLAN, D.
Numerical Simulation on Typhoon Surge and Surge Estimation of Huanghe River Estuary Region in Bohai Sea, (in Chinese),
W89-00543 2L

WEPF, D. H.
Hydrodynamic-Stiffness Matrix Based on Boundary Elements for Time-Domain Dam-Reservoir-Soil Analysis,
W89-00447 8B

WESTERNHAGEN, H. V.
Developmental Defects in Pelagic Fish Embryos from the Western Baltic,
W89-00315 5C

WETZEL, E. D.
Activated Sludge Systems with Biomass Particle Support Structures,
W89-01256 5D

WETZEL, R. G.
Photosynthesis of Submersed Macrophytes in Acidified Lakes: II. Carbon Limitation and Utilization of Benthic CO2 Sources,
W89-00095 5C

WETZEL, R. L.
Model of Zostera marina L. Photosynthesis and Growth: Simulated Effects of Selected Physical-Chemical Variables and Biological Interactions,
W89-00130 2L

WEVERS, M. J.
Utility of Laboratory Streams for Ecosystem Toxicity Studies,
W89-01059 5B

WHARTON, R. A.
Physiological Ecology of Bluegreen Algal Mats (Modern Stromatolites) in Antarctic Oasis Lakes,
W89-00185 2H

WHEATLEY, R. E.
Ochre Deposits and Associated Bacteria in Some Field Drains in Scotland,
W89-00412 2G

WHEELER, D. A.
Summer of 1987 in North-East England,
W89-00463 2B

WHITAKER, S.
Dispersion in Heterogeneous Porous Media: 1. Local Volume Averaging and Large-Scale Averaging,
W89-00699 5B

Dispersion in Heterogeneous Porous Media: 2. Predictions for Stratified and Two-Dimensional Spatially Periodic Systems,
W89-00700 5B

WHITE, B. S.
Feeding and Swimming Behavior in Grazing Microzooplankton,
W89-00382 2H

WHITE, D. C.
Microbial Biomass, Activity, and Community Structure of Water and Particulates Retrieved by Backflow from a Waterflood Injection Well,
W89-00334 5B

WHITE, L. R.
Contaminant Transport in Fractured Porous Media: Steady State Solutions by a Boundary Integral Method,
W89-00982 5B

WHITE, W. B.
Storm Response of the Karstic Carbonate Aquifer of Southcentral Kentucky,
W89-00349 2A

WHITEHEAD, P. G.
Modelling the Effects of Acid Deposition: Estimation of Long-Term Water Quality Responses in Forested Catchments in Finland,
W89-00894 5B

Stream Acidification Trends in the Welsh Uplands: A Modelling Study of the Llyn Brianne Catchments,
W89-01206 5C

WHITMAN, R. P.
Homing of Adult Chinook Salmon after Brief Exposure to Whole and Dispersed Crude Oil,
W89-00375 5C

WIDBOM, B.
Response of Benthic Meiofauna to Nutrient Enrichment of Experimental Marine Ecosystems,
W89-01033 5C

WIDDOWSON, M. A.
Numerical Transport Model for Oxygen- and Nitrate-Based Respiration Linked to Substrate and Nutrient Availability in Porous Media,
W89-01251 5D

WIEDER, R. K.
Cycling of Inorganic and Organic Sulfur in Peat from Big Run Bog, West Virginia,
W89-00208 2H

WIENER, J. G.
Does pH Affect Fish Species Richness when Lake Area is Considered,
W89-00324 2H

WIESMANN, U.
Kinetics and Reaction Engineering of Anaerobic Sewage Treatment (Kinetik und Reaktionstechnik der anaeroben Abwasserreinigung),
W89-01185 5D

WIKTOR, K.
Contemporary Changes in Coastal Biocenoses of the Gdansk Bay (South Baltic), A Review,
W89-00254 2L

WILCOCK, P. R.
Experimental Study of Incipient Motion in Mixed-Sized Sediment,
W89-00721 2J

Methods for Estimating the Critical Shear Stress of Individual Fractions in Mixed-Size Sediment,
W89-00720 2J

WILE, I.
Richness of Aquatic Macrophyte Floras of Soft Water Lakes of Differing pH and Trace Metal Content in Ontario, Canada,
W89-00103 5C

WILKINSON, M.
Attached Algae of the Clyde and Garnock Estuaries,
W89-00807 5C

WILLEN, E.
Phytoplankton and Reversed Eutrophication in Lake Malaren, Central Sweden, 1965-1983,
W89-01188 5G

WILLIAMS, A. N.
Earthquake Response of Submerged Circular Arch,
W89-00306 8A

WILLIAMS, D. J. A.
Aluminum Speciation in Surface Waters from a Welsh Upland Area,
W89-01055 5B

WILLIAMS, D. T.
Review of the Use of XAD Resins to Concentrate Organic Compounds in Water,
W89-01215 5A

WILLIAMS, F. P.
Detection of Environmental Viruses in Sludge: Enhancement of Enterovirus Plaque Assay Titers with 5-Iodo-2'-Deoxyuridine and Comparison to Adenovirus and Coliphage Titers,
W89-01220 5A

WILLIAMS, J. H.
Differences in the Spectral Characteristics of Birch Canopies Exposed to Simulated Acid Rain,
W89-00849 5C

WILLIAMS, P. C.
Financing Strategies for Small Systems,
W89-01113 5F

WILLIAMS, P. T.
Dissolution of Trace Metals from Particles of Industrial Origin and Its Influence on the Composition of Rainwater,
W89-01149 5B

WILLIAMS, R. D.
Vertical Variability of Soil Properties in a Small Watershed,
W89-00354 2G

WILLIS, J. P.
Bathymetry, Environmental Parameters and Sediments of the Bot River Estuary, S.W. Cape Province.
W89-00651 2L

WILMES, R.
Studies of the Oxidative Photoinduced Degradation of Silicones in the Aquatic Environment,
W89-00617 5B

WILMOT, P. D.
Kinetics of Sulfide Oxidation by Dissolved Oxygen,
W89-01130 5D

WINDSOR, J. S.
Programming Model for the Optimal Planning of Water Supply Systems,
W89-00452 6A

WINFREY, M. R.
Effects of Acidification on Mercury Methylation, Demethylation, and Volatilization in Sediments from an Acid-Susceptible Lake,
W89-00731 5B

WINKLER, D. W.
Spatial and Temporal Distribution Patterns of Three Trophic Levels in a Saline Lake,
W89-00219 2H

WINSLETT, B. J.
Global Environment: A Proposal to Eliminate Marine Oil Pollution,
W89-00521 5G

WISMER, D. A.
Application of Ecological Modelling: Impact of Thermal Effluent on a Smallmouth Bass Population,
W89-00317 5C

WITKOWSKI, P. J.
Sorption and Desorption Dynamics of Aroclor 1242 to Natural Sediment,
W89-00991 5B

WITT, A.
Waste Transformer Oil and PCB Toxicity to Rainbow Trout,
W89-00328 5C

WITTENBURG, E.
Effect of 3,4 Benzopyrene on the Photosynthetic and Respiratory Intensity of the Green Alga Scenedesmus quadricauda (Der Einfluss von 3,4-Benzpyren aud die Photosynthese- une Respirationsintensitat der Gruenalge Scenedesmus quadricauda),
W89-00135 5C

WITTNER, I.
New Aspects of the Sulfur Cycle, with Special Reference to Shallow Waters,
W89-00183 5B

WOJCIECHOWSKA, W.
Changes in Phytoplankton Over a Ten-Year Period in a Lake Undergoing De-Eutrophication due to Surrounding Peat Bogs,
W89-00196 2H

WOJCIECHOWSKI, I.
Changes in Phytoplankton Over a Ten-Year Period in a Lake Undergoing De-Eutrophication due to Surrounding Peat Bogs,
W89-00196 2H

WOLANSKI, E.
Outwelling from Tropical Tidal Salt Flats,
W89-00140 2L

WOLAVER, T. G.
Exchange of Phosphorus between a Euhaline Vegetated Marsh and the Adjacent Tidal Creek,
W89-00283 5B

WOLF, J. P.
Hydrodynamic-Stiffness Matrix Based on Boundary Elements for Time-Domain Dam-Reservoir-Soil Analysis,
W89-00447 8B

WOLFF, R. J.
Distribution of Chitinolytic Bacteria in Various Aquatic Systems: A Comparative Study,
W89-00402 2H

WOLLAST, R.
Determination of Cobalt Ions in Natural Waters Using Differential Pulse Adsorptive Stripping Voltammetry,
W89-00480 5A

WOLMARANS, C. T.
Uptake and Distribution of Copper Sulphate and Its Effect on the Respiration Rate of the Hemocyanin-Producing Freshwater Snail Lymnaea natalensis,
W89-01155 5G

WONG, D. K. H.
Modelling of Flow Through Potash Tailings Piles,
W89-00388 5B

WONG, G.
Emissions of Chlorinated Organics from a Municipal Sewage Sludge Burning Incinerator,
W89-00607 5B

WONNEBERGER, K.
Examination of the Connection Between the Patchiness of Benthic Nutrient Efflux and Epiphytobenthos Patchiness on Intertidal Flats,
W89-00161 2L

WOO, H. S.
Suspension of Large Concentrations of Sands,
W89-00900 2J

WOO, M.
Pipe Flow in James Bay Coastal Wetlands,
W89-00047 2A

WOO, M. K.
Runoff Generation in a Low Arctic Drainage Basin,
W89-01207 2A

WOOD, A. L.
Sorption Nonequilibrium During Solute Transport,
W89-00988 5B

WOOD, E.
Distributed Parameter Approach for Evaluating the Accuracy of Groundwater Model Predictions: 1. Theory,
W89-00711 2F

Distributed Parameter Approach for Evaluating the Accuracy of Groundwater Model Predictions: 2. Application to Groundwater Flow,
W89-00712 2F

WOOD, E. F.
Hydrological Heterogeneity Catchment Morphology and Catchment Response,
W89-01024 2A

WOOD, R.
Outstanding Problems in River Regulation,
W89-00963 4A

WOODSIDE, G. D.
Analytical Solution for Aquifer Decontamination by Pumping,
W89-00977 5G

WOODWARD, D. F.
Leaching of Retorted Oil Shale: Assessing the Toxicity to Colorado Squawfish, Fathead Minnows, and Two Food-Chain Organisms,
W89-00329 5C

WOODWARD, E. M. S.
Nitrite and Ammonia in the Tamar Estuary,
W89-00154 5B

WORD, J. Q.
Laboratory Study of the Accumulation and Toxicity of Contaminants at the Sea Surface from Sediments Proposed for Dredging,
W89-00858 5E

WORTMAN, A. T.
Metabolic Processes Involved in Repair of Escherichia coli Cells Damaged by Exposure to Acid Mine Water,
W89-00727 5C

WREN, C. D.
Depressed Mercury Levels in Biota from Acid and Metal Stressed Lakes Near Sudbury, Ontario,
W89-00442 5B

WRIGHT, A.
Spatial Variability of Short-Term Rainfall Amounts in a Coastal Mountain Region of Southern Africa,
W89-00932 2B

WRIGHT, D. A.
Effects of Cadmium on Early Developmental Stages of the Sheepshead Minnow (Cyprinodon Variegatus),
W89-01091 5C

WRIGHT, J. R.
Planning Indiana's Water Infrastructure from a Competitive Perspective,
W89-00880 6B

WU, S.
Numerical Modeling of Sorption Kinetics of Organic Compounds to Soil and Sediment Particles,
W89-00981 5B

WU, T.-P.
Simultaneous Removal of Heavy Metal Ions from Wastewater by Foam Separation Techniques,
W89-00265 5D

WUEST, A.
Origin and Size of Hypolimnic Mixing in Urnersee, the Southern Basin of Vierwaldstattersee (Lake Lucerne),
W89-00023 2H

WURSTER, C. F.
Induced Resistance to Polychlorinated Biphenyls Confers Cross-Resistance and Altered Environmental Fitness in a Marine Diatom,
W89-00860 5C

PCB-resistant Diatoms in the Hudson River Estuary,
W89-00284 5C

WYLIE, P. L.
Comparing Headspace with Purge and Trap for Analysis of Volatile Priority Pollutants,
W89-01119 5A

WYSOCKEY, M. H.
Great Lakes Shore Erosion,
W89-00133 4D

XIA, L.
Trace Element Content in Drinking Water of Nasopharyngeal Carcinoma Patients,
W89-00048 5C

XIANGQUAN, Q.
Studies on Marine Humic Substances: III. The Distribution of Humic Substances in Seawater and Sediments in the Estuary of Changjiang River and East China Sea, (in Chinese),
W89-00541 2L

Studies on Marine Humic Substances: IV. The Distribution of Humic Substances in the Seawater and Sediments of Huanghe River Estuary, (in Chinese),
W89-00545 2L

XINGLUN, K.
Determination of Gross-Beta Radioactivity in Water of the Changjiang River and Sea Water Near Its Entrance to Sea, (in Chinese),
W89-00534 2H

XUE, H. B.
Binding of Heavy Metals to Algal Surfaces,
W89-01227 5B

XUEMIN, C.
Intensive Hydro Development of the Hongshui River,
W89-01002 8C

XUEZHONG, P.
Chromium Speciation in the Huanghe River and Its Estuarine Region, (in Chinese),
W89-00544 5B

XUNRONG, S.
Determination of Trace Chromium in Natural Water by Polarographic Catalytic Wave Analysis, (in Chinese),
W89-00538 5A

YAGI, A.
Dissolved Organic Carbon and Manganese in the Boundary of the Oxic and Anoxic Layers in Lakes Fukami-ike and Suigetsu-ko,
W89-00771 2H

Seasonal Change of Iron and Manganese in Lake Fukami-ike: Occurrence of Turbid Manganese Layer,
W89-00770 2H

YAKUBONIS, R. A.
Technology of Casting Precast Pipeline Elements of the Kaisiadory's Pumped-Storage Station,
W89-00045 8F

YAMANE, T.
Continuous-flow System for the Determination of Cobalt in Sea and River Water: In-line Preconcentration/Separation Coupled with Catalytic Determination,
W89-00063 5A

YAMAUCHI, F.
Evaluation of Aquatic Environmental Fate of 2,4,6-Trichlorophenol with a Mathematical Model,
W89-00616 5B

YAN, N. D.
Richness of Aquatic Macrophyte Floras of Soft Water Lakes of Differing pH and Trace Metal Content in Ontario, Canada,
W89-00103 5C

YAN-NIAN, Y.
Assessing the Influence of Environmental Parameters on the Hydrological Cycle,
W89-00916 2A

YANCHER, V. B.
Evaluation of the Reliability of Wave-Protection Slab Revetments of Embankment Slopes,
W89-01176 8D

YANNOPOULOS, S.
Sensitivity Analysis of Closed-Form Analytical Hydraulic Conductivity Models,
W89-01204 2G

YANT, P. R.
Spatial and Temporal Variability of the Index of Biotic Integrity in Three Midwestern Streams,
W89-00026 2E

YANUKA, M.
Determination of Electrical Conductivity Using Time Domain Reflectometry: Soil and Water Experiments in Coaxial Lines,
W89-00702 2G

Multiple Reflection and Attenuation of Time Domain Reflectometry Pulses: Theoretical Considerations of Applications to Soil and Water,
W89-00701 7B

YASUNO, M.
Sedimentation of Phytoplankton Populations Dominated by Microcystis in a Shallow Lake,
W89-00233 2H

YATES, S. R.
Three-Dimensional Radial Dispersion in a Variable Velocity Flow Field,
W89-00715 5B

YAUNZEMA, V. M.
Some Results of Investigating the State of the Powerhouse of the Plyavinyas Hydroelectric Station,
W89-01180 8D

YEAROUT, R.
Contamination of Farmstead Wells by Pesticides, Volatile Organics, and Inorganic Chemicals in Kansas,
W89-00946 5B

YEMENICIOGLU, S.
Two Toxicants, Mercury and Tin in the Gulf of Iskenderun,
W89-00570 5B

YEN, C. J.
Determinations of Suspended Sediment Concentrations from Multiple Day Landsat and AVHRR Data,
W89-00064 7B

YI-CHUN, X.
Assessing the Influence of Environmental Parameters on the Hydrological Cycle,
W89-00916 2A

YI, Y.
Determination of Gross-Beta Radioactivity in Water of the Changjiang River and Sea Water Near Its Entrance to Sea, (in Chinese),
W89-00534 2H

YIAO-MEI, Z.
Assessing the Influence of Environmental Parameters on the Hydrological Cycle,
W89-00916 2A

YILMAZ, A.
Long Term Impact of Dissolved Dispersed Petroleum Hydrocarbons (DDPH) in Gulf of Iskenderun,
W89-00567 5B

YIN, Q.
Determination of Free Cyanide in Water by Released Fluorescence of a Dissociated Ternary Complex,
W89-00477 5A

YING, W.
RO Desalination in Northwest China,
W89-01065 3A

YOCH, D. C.
Relationship between Nitrogen-Fixing Sulfate Reducers and Fermenters in Salt Marsh Sediments and Roots of Spartina alterniflora,
W89-00732 2L

YONGEN, B.
Preliminary Study on the Migration and Transformation of Heavy Metals in the Sewage-Seawater Mixing Zone of Jinzhou Bay, (in Chinese),
W89-00199 5B

YOSHIDA, K.
Evaluation of Aquatic Environmental Fate of 2,4,6-Trichlorophenol with a Mathematical Model,
W89-00616 5B

YOSHIZAKI, T.
Mechanism of Inactivation of Tobacco Mosaic Virus with Ozone,
W89-01229 5F

YOUNG, A. L.
Long-term Study of Ecosystem Contamination with 2,3,7,8-Tetrachlorodibenzo-p-dioxin,
W89-00603 5B

YOUNG, T. C.
Factors Affecting the Efficiency of Some Estimates of Fluvial Total Phosphorus Load,
W89-01249 5B

YOUNGS, E. G.
Soil Physics and Hydrology,
W89-01026 2G

YOUNOS, T. M.
Pesticides: A Continuing Dilemma,
W89-01122 5B

YOUXIAN, Y.
Catalytic Determination of Copper in Natural Water at Microgram/L Level by Flow Injection Analysis, (in Chinese),
W89-00201 7B

YSSEL, E.
Uptake and Distribution of Copper Sulphate and Its Effect on the Respiration Rate of the Hemocyanin-Producing Freshwater Snail Lymnaea natalensis,
W89-01155 5G

YTELL, E.
Rural Community Assistance Program,
W89-01115 5F

YU, S.
Identification of Rainfall Type From Weather Radar Data,
W89-00842 2B

YUANSHENG, Y.
Characteristics of Distribution and Migration of Phosphorus in Deposits of Dianchi Lake, (in Chinese),
W89-00200 5B

YUDINA, N. V.
Technology of Casting Precast Pipeline Elements of the Kaisiadory's Pumped-Storage Station,
W89-00045 8F

YUMEI, L.
Effects of Six Heavy Metals on Hatching Eggs and Survival of Larva of Marine Fish, (in Chinese),
W89-00533 5C

YURENEVA, E. V.
Seismic Stress State of Underground Structures with Consideration of the Effect of the Free Surface,
W89-00035 8E

YUZHONG, F.
Preliminary Study on the Migration and Transformation of Heavy Metals in the Sewage-Seawater Mixing Zone of Jinzhou Bay, (in Chinese),
W89-00199 5B

ZAIKOWSKI, L. A.
Induced Resistance to Polychlorinated Biphenyls Confers Cross-Resistance and Altered Environmental Fitness in a Marine Diatom,
W89-00860 5C

ZAJDEL, R. K.
Acute Toxicity of Thiocyanate to Trout,
W89-00330 5C

ZAKARAY, D.
Predictive Structure-Toxicity Model with Daphnia magna,
W89-00591 5C

ZARTMAN, R. E.
Intrapedal Macropore Distribution and Infiltration Rate of Three Friona Polypedons,
W89-00408 2G

ZEBCHUK, W. D.
Determination of Electrical Conductivity Using Time Domain Reflectometry: Soil and Water Experiments in Coaxial Lines,
W89-00702 2G

Multiple Reflection and Attenuation of Time Domain Reflectometry Pulses: Theoretical Considerations of Applications to Soil and Water,
W89-00701 7B

ZEELIN, S.
Determination of Electrical Conductivity Using Time Domain Reflectometry: Soil and Water Experiments in Coaxial Lines,
W89-00702 2G

ZEGELIN, S.
Multiple Reflection and Attenuation of Time Domain Reflectometry Pulses: Theoretical Considerations of Applications to Soil and Water,
W89-00701 7B

ZEHNDER, A. J. B.
Simulation Model for Biotransformation of Xenobiotics and Chemotaxis in Soil Columns,
W89-00989 5B

ZELENEVSKII, Z. L.
Modification of Turbine Runner Blades at the Chirkey Hydroelectric Station,
W89-00555 8C

ZENTNER, J.
Wetland Projects of the California State Coastal Conservancy: An Assessment,
W89-01069 6E

ZEPP, R. G.
Effects of Aquatic Humic Substances on Analysis for Hydrogen Peroxide Using Peroxidase-Catalyzed Oxidations of Triarylmethanes or p-Hydroxyphenylacetic Acid,
W89-00634 7B

Reactivity of the Carbonate Radical with Aniline Derivatives,
W89-01088 5B

ZHANG, J.
Concentrations of Trace Metals in the Qiantagnjiang River and its Estuary in Southern China,
W89-00443 5B

ZHDANOW, V. S.
Power Facilities of the Moscow Canal,
W89-00053 8C

ZHELEZNYAKOV, G. V.
Effect of Runoff Variability on Deformation of Erodible Channels near Structures,
W89-00072 2J

ZHELING, C.
Preliminary Study on the Migration and Transformation of Heavy Metals in the Sewage-Seawater Mixing Zone of Jinzhou Bay, (in Chinese),
W89-00199 5B

ZHIQING, L.
Chemical Behavior of Meta! Elements in the Sediments in the Hanjiang River Estuary and Shantou Port, (in Chinese),
W89-00202 2L

ZHONG, W. Z.
Sorption and Degradation of Aldicarb and Its Oxidation Products in a Soil-Water Flow System as a Function of pH and Temperature,
W89-01164 5B

ZHONGXI, J.
Analysis of the Effects of Suspended Sediment of Huanghe River on Harbor Construction by Using NOAA Images, (in Chinese),
W89-00536 2J

ZHOU, X.
Trace Element Content in Drinking Water of Nasopharyngeal Carcinoma Patients,
W89-00048 5C

ZILBERMAN, A.
Trihalomethane Formation in High-Bromide Lake Galilee Water,
W89-00426 5F

ZIMMER, D.
Subsurface Drainage Peak Flows in Shallow Soil,
W89-00749 4A

ZIMMER-FAUST, R. K.
Acute Toxicities of Eleven Metals to Early Life-History Stages of the Yellow Crab Cancer anthonyi,
W89-00386 5C

ZIMMERMAN, J. T. F.
Heat Balance of a Tidal Flat Area,
W89-00148 2L

ZIMMERMANN, G. M.
Intermittent Destratification: A Therapy Measure against Cyanobacteria in Lakes,
W89-00639 5G

ZIMNIK, P. R.
Binding and Removal of Aluminum Ions in Waters by an Algal Biomass.
W89-00478 5F

ZINDER, B.
Aerosol and Hydrometeor Concentrations and Their Chemical Composition during Winter Precipitation along a Mountain Slope: I. Temporal

Evolution of the Aerosol, Microphysical and Meteorological Conditions,
W89-01150 2B

ZIQIANG, L.
Chemical Behavior of Metal Elements in the Sediments in the Hanjiang River Estuary and Shantou Port, (in Chinese),
W89-00202 2L

ZIRSCHKY, J.
Use of Duckweed for Wastewater Treatment,
W89-01128 5D

ZMIROU, D.
Comparison of Bacterial Indicators and Sampling Programs for Drinking Water Systems,
W89-00733 5A

ZONFRILLO, B.
Population Dynamics of Seabirds in the Firth of Clyde,
W89-00822 2L

ZONGXIAN, Y.
Hydrological Features of Poyang Lake (II), (in Chinese),
W89-00535 2H

Hydrological Features of Poyang Lake, (in Chinese),
W89-00532 2H

ZONGYAN, G.
China's Experience with Underground Works,
W89-01007 8H

ZYGMUNTOWA, J.
Development of Microorganisms on the Background of Organic Matter in Forest Ecosystem Waters,
W89-00080 2H

ZYRYANOV, A. G.
New Life for Small Hydroelectric Stations in Kirgizia,
W89-00042 8C

ORGANIZATIONAL INDEX

AALBORG UNIVERSITETSCENTER (DENMARK). DEPT. OF CIVIL ENGINEERING.
Effect of Sulfate and Organic Matter on The Hydrogen Sulfide Formation in Biofilms of Filled Sanitary Sewers,
W89-00510 5D

AARHUS UNIV. (DENMARK). BOTANICAL INST.
Leaf Production and Nitrogen and Phosphorus Tissue Content of Littorella uniflora (L.) Aschers. in Relation to Nitrogen and Phosphorus Enrichment of the Sediment in Oligotrophic Lake Hampen, Denmark,
W89-00101 5C

ABERDEEN UNIV. (SCOTLAND). DEPT. OF GEOGRAPHY.
Coastal Topography of the Moray Firth,
W89-00775 2L

ABERDEEN UNIV. (SCOTLAND). DEPT. OF ZOOLOGY.
Intertidal Macrofauna of Nigg Bay,
W89-00780 2L

Moray Firth Marine Fouling Communities,
W89-00781 2L

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W89-00694 5B

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W89-00202 2L

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W89-00200 5B

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W89-00531 2H

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W89-00480 5A

Effects of Six Heavy Metals on Hatching Eggs and Survival of Larva of Marine Fish, (in Chinese),
W89-00533 5C

Determination of Gross-Beta Radioactivity in Water of the Changjiang River and Sea Water Near Its Entrance to Sea, (in Chinese),
W89-00534 2H

Extraction and Determination of Chlorophyll from Benthic Green Algae with Dimethyl Sulfoxide, (in Chinese),
W89-00539 7B

Studies on Marine Humic Substances: III. The Distribution of Humic Substances in Seawater and Sediments in the Estuary of Changjiang River and East China Sea, (in Chinese),
W89-00541 2L

Numerical Simulation on Typhoon Surge and Surge Estimation of Huanghe River Estuary Region in Bohai Sea, (in Chinese),
W89-00543 2L

Chromium Speciation in the Huanghe River and Its Estuarine Region, (in Chinese),
W89-00544 5B

Studies on Marine Humic Substances: IV. The Distribution of Humic Substances in the Seawater and Sediments of Huanghe River Estuary, (in Chinese),
W89-00545 2L

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W89-00247 2H

Changes in Chlorophyll Contents of Swietokrzyskie Lake Phytoplankton, as Related to Qualitative and Quantitative Fluctuations of Phytoplankton Density and of the Physicochemical Conditions in this Lake in Summer 1979,
W89-00257 5C

Qualitative and Quantitative Changes in Phytoplankton on the Background of Physicochemical Changes in the Water of Swietokrzyskie Lake in the Years 1977-1979,
W89-00258 5C

AGRICULTURAL RESEARCH SERVICE, BELTSVILLE, MD.
Encapsulated Herbicides Could Curb Ground Water Pollution,
W89-00964 5G

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Progress in Developing an Operational Snowmelt-Runoff Forecast Model with Remote Sensing Input,
W89-00891 2A

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W89-00760 7B

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Vertical Variability of Soil Properties in a Small Watershed,
W89-00354 2G

Effect of Assumed Unit Gradient During Drainage on the Determination of Unsaturated Hydraulic Conductivity and Infiltration Parameters,
W89-00407 2G

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W89-00717 2E

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W89-01027 5B

AGRICULTURAL UNIV., WAGENINGEN (NETHERLANDS). DEPT. OF MICROBIOLOGY.
Simulation Model for Biotransformation of Xenobiotics and Chemotaxis in Soil Columns,
W89-00989 5B

Effect of Environmental Conditions on the Occurrence of Microthrix parvicella in Activated Sludge,
W89-01217 5D

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W89-00625 5D

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W89-00196 2H

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W89-00255 5D

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W89-01194 2H

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W89-00138 2H

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W89-01193 3C

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W89-00418 2B

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W89-00322 4C

ALASKA UNIV., FAIRBANKS. INST. OF ARCTIC BIOLOGY.
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W89-00908 2G

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Microbially Mediated Mn(II) Oxidation in an Oligotrophic Arctic Lake,
W89-00335 2H

ALBERTA UNIV., EDMONTON. DEPT. OF CIVIL ENGINEERING.
Procedure for Evaluating Municipal Solid Waste Leachate Components Capable of Causing Volume Shrinkage in Compacted Clay Soils,
W89-00621 5E

Plunging and Streaming Flows in Pool and Weir Fishways,
W89-00904 2E

Review of the Use of XAD Resins to Concentrate Organic Compounds in Water,
W89-01215 5A

ALBERTA UNIV., EDMONTON. DEPT. OF GEOLOGY.
Continuum Approach for Modeling Mass Transport in Fractured Media,
W89-00980 5B

Contaminant Hydrogeology Dollars and Sense,
W89-01028 5B

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Environmental Conditions in Abu Kir Bay, East of Alexandria: I. Physico-chemical Characteristics and Water Circulation,
W89-00565 5B

Environmental Conditions in Abu Kir Bay, East of Alexandria: II. Plankton Distribution, Downstream from Land-Based Effluents,
W89-00578 5C

ALFRED-WEGENER-INST. FUER POLARFORSCHUNG, BREMERHAVEN (GERMANY, F.R.).
Chlorinated Hydrocarbons in Sediments of the Elbe River and the Elbe Estuary,
W89-00614 5B

AMERICAN WATER WORKS ASSOCIATION, DENVER, CO.
AWWA Small Systems Program,
W89-01114 5F

AMERICAN WATER WORKS SERVICE CO., VOORHEES, NJ. SYSTEM WATER QUALITY DEPT.
Occurrence of Radon in Well Supplies,
W89-01105 5B

AMSTERDAM WATER SUPPLY (NETHERLANDS).
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W89-00421 5F

AMT DER SALZBURGER LANDESREGIERUNG (AUSTRIA). UNTERABTEILUNG WASSERBAU.
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W89-00164 4A

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W89-00734 5A

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Operating a Small Full-Scale Ion Exchange System for Uranium Removal,
W89-01107 5F

ARCTIC BIOLOGICAL STATION, STE. ANNE DE BELLEVUE (QUEBEC).
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W89-01232 2L

ARIZONA UNIV., TUCSON.
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W89-00837 6D

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Biosorption of Organic Halide in a Kraft Mill Generated Lagoon,
W89-01138 5D

Factors Affecting Coagulation with Aluminum Sulfate: I. Particle Formation and Growth,
W89-01221 5F

Factors Affecting Coagulation with Aluminum Sulfate: II. Dissolved Organic Matter Removal,
W89-01222 5F

ARIZONA UNIV., TUCSON. DEPT. OF HYDROLOGY AND WATER RESOURCES.
Maximum Likelihood Criterion for Use With Data Collected at Unequal Time Intervals,
W89-00723 2E

ARIZONA UNIV., TUCSON. DEPT. OF MICROBIOLOGY AND IMMUNOLOGY.
Characterization of the Interaction Between Viruses and a Solid Polymeric Contact Disinfectant,
W89-00884 5F

ARIZONA UNIV., TUCSON. INST. OF ATMOSPHERIC PHYSICS.
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W89-00474 2B

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W89-00300 5D

ARKANSAS UNIV., FAYETTEVILLE. DEPT. OF GEOGRAPHY.
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W89-00273 2B

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W89-00489 5D

Empirical Correlation for Estimating Pressure Drop Across Clogged Filters,
W89-00924 5F

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W89-00490 5G

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W89-00640 5A

Aspects of Atmospheric Pollutant Origin and Deposition Revealed by Multielemental Observations at a Rural Location in Eastern Canada,
W89-01264 5B

Winter Cloud Water and Air Composition in Central Ontario,
W89-01265 5C

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W89-00387 2C

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W89-01251 5D

Activated Sludge Systems with Biomass Particle Support Structures,
W89-01256 5D

AUSTRALIAN INST. OF MARINE SCIENCES, TOWNSVILLE.
Outwelling from Tropical Tidal Salt Flats,
W89-00140 2L

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W89-00766 2L

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W89-00919 5F

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W89-01192 6G

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W89-00442 5B

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W89-00094 5C

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W89-00630 5D

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W89-00920 5F

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W89-00213 2H

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W89-00645 5A

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W89-01184 5G

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W89-00142 2L

Sediments in the Estuarine Environment of the Tigris/Euphrates Delta; Iraq; Arabian Gulf,
W89-01083 2L

BATTELLE COLUMBUS DIV., OH. ENVIRONMENTAL PHYSICS AND CHEMISTRY SECTION.
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W89-00598 5B

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W89-00914 2F

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Acidic Deposition Distribution and Episode Statistics from the MAP3S Network Database,
W89-01151 5B

BATTELLE PACIFIC NORTHWEST LABS., RICHLAND, WA. ENVIRONMENTAL SCIENCES DEPT.
Avoidance of a Water-Soluble Fraction of Coal Liquid by Fathead Minnows,
W89-00321 5C

BATTELLE PACIFIC NORTHWEST LABS., RICHLAND, WA. GEOSCIENCES DEPT.
Sensitivity of Four Monitoring Well Sampling Systems to Low Concentration of Three Volatile Organics,
W89-00944 5A

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Sea-Surface Microlayer of Puget Sound: Part I: Toxic Effects on Fish Eggs and Larvae,
W89-00853 5C

Sea-Surface Microlayer of Puget Sound: Part II: Concentrations of Contaminants and Relation to Toxicity,
W89-00854 5C

Laboratory Study of the Accumulation and Toxicity of Contaminants at the Sea Surface from Sediments Proposed for Dredging,
W89-00858 5E

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W89-00167 2H

Intermittent Destratification: A Therapy Measure against Cyanobacteria in Lakes,
W89-00639 5G

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W89-00730 5A

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W89-00688 2K

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W89-01255 8C

BEDFORD INST. OF OCEANOGRAPHY, DARTMOUTH (NOVA SCOTIA).
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W89-01071 7C

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W89-01008 2J

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W89-00926 6B

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W89-01148 5B

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W89-00990 5B

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W89-00632 5D

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W89-00128 2H

BIOLOGISCHE ANSTALT HELGOLAND (GERMANY, F.R.)
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W89-00315 5C

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W89-00855 5C

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W89-01037 2L

Gas Chromatographic-Mass Spectrometric Investigations on Lipophilic Anthropogenic Substances in Environmental Samples. II: A Splitter for the Simultaneous Detection of Capillary Gas Chromatograms by up to Four Different GC-Detectors,
W89-01086 5A

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W89-00842 2B

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W89-01112 6E

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W89-00428 5F

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W89-00221 2L

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W89-00767 2J

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W89-01197 2F

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W89-00788 5G

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W89-00193 2H

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W89-01118 5F

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W89-00909 2H

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W89-00504 5A

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W89-00127 5C

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W89-00467 6A

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W89-01058 5C

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W89-00334 5B

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W89-00458 6A

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W89-01067 6E

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W89-01068 6E

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W89-00902 5E

Nonaqueous Phase Liquid Transport and Cleanup: I. Analysis of Mechanisms,
W89-00968 5B

Nonaqueous Phase Liquid Transport and Cleanup: II. Experimental Studies,
W89-00969 5B

CALIFORNIA UNIV., BERKELEY. DEPT. OF FORESTRY AND RESOURCES MANAGEMENT.
Effects of Discharge Fluctuation and the Addition of Fine Sediment on Stream Fish and Macroinvertebrates Below a Water-Filtration Facility,
W89-01061 5C

CALIFORNIA UNIV., BERKELEY. DEPT. OF PLANT AND SOIL BIOLOGY.
Hydrogen Ion Concentration and Alkalinity of Reservoir Water in the Sierra Nevada, California, and Correlations with Air Pollutants,
W89-01165 5B

CALIFORNIA UNIV., BERKELEY. DEPT. OF SOCIAL ADMINISTRATIVE HEALTH SERVICES.
Developing and Assessing a Model of Residential Water Conservation,
W89-00881 3D

CALIFORNIA UNIV., DAVIS.
State Equitable Apportionment of Western Water Resources,
W89-01267 6E

CALIFORNIA UNIV., DAVIS. DEPT. OF GEOLOGY.
Fog Drip as a Source of Groundwater Recharge in Northern Kenya,
W89-00984 2F

CALIFORNIA UNIV., DAVIS. DEPT. OF LAND, AIR AND WATER RESOURCES.
Nutrient and Light Limitation of Algae in Two Northern California Streams,
W89-00296 2H

CALIFORNIA UNIV., DAVIS. DEPT. OF WILDLIFE AND FISHERIES BIOLOGY.
Influence of Temperature on Microhabitat Choice by Fishes in a California Stream,
W89-00027 2H

Microhabitat Use by an Assemblage of California Stream Fishes: Developing Criteria for Instream Flow Determinations,
W89-00319 6D

CALIFORNIA UNIV., DAVIS. DIV. OF ENVIRONMENTAL STUDIES.
Seasonal Phytoplankton Demographic Processes and Experiments on Interspecific Competition,
W89-00906 2H

CALIFORNIA UNIV., DAVIS. INST. OF ECOLOGY.
Recurrence of Daphnia rosea in Lake Tahoe: Analysis of a Population Pulse,
W89-00216 2H

CALIFORNIA UNIV., RIVERSIDE. DEPT. OF SOIL AND ENVIRONMENTAL SCIENCES.
Three-Dimensional Radial Dispersion in a Variable Velocity Flow Field,
W89-00715 5B

CALIFORNIA UNIV., SANTA BARBARA. DEPT. OF BIOLOGICAL SCIENCES.
Spatial and Temporal Distribution Patterns of Three Trophic Levels in a Saline Lake,
W89-00219 2H

CALIFORNIA UNIV., SANTA BARBARA. MARINE SCIENCE INST.
Acute Toxicities of Eleven Metals to Early Life-History Stages of the Yellow Crab Cancer anthonyi,
W89-00386 5C

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Faunas of Land-Locked Lagoons: Chance Differences and the Problems of Dispersal,
W89-00141 2L

CAMERINO UNIV. (ITALY). INST. DI BOTANICA.
Diatoms and Other Algae from the Thermal-Sulphur Springs of Triponzo (Central Italy),
W89-00190 2H

CAPE TOWN UNIV. (SOUTH AFRICA). DEPT. OF CIVIL ENGINEERING.
STASOFT: A User-Friendly Interactive Computer Program for Softening and Stabilisation of Municipal Waters,
W89-00935 5F

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Bathymetry, Environmental Parameters and Sediments of the Bot River Estuary, S.W. Cape Province.
W89-00651 2L

CAPE TOWN UNIV. (SOUTH AFRICA). DEPT. OF OCEANOGRAPHY.
Numerical Model for the Wind-Driven Circulation in the Bot River Estuary,
W89-00652 2L

CAPE TOWN UNIV. (SOUTH AFRICA). DEPT. OF ZOOLOGY.
Historical Records of the Bot River Estuarine System,
W89-00653 2L

Physical and Chemical Characteristics of the Waters of the Bot River Estuary, South Africa,
W89-00655 2L

Primary Productivity of the Bot River Estuary, South Africa,
W89-00656 2L

Effect of Salinity and Temperature Variations on the Bacterial Population in the Bot River Estuary,
W89-00657 2L

Annual Cycle of Free-Floating Bacteria in the Bot River Estuary,
W89-00658 2L

Benthic Macrofauna of the Bot River Estuary, South Africa, with a Note on Its Meiofauna,
W89-00660 2L

Ecological Role of the Red-Knobbed Coot, Fulica cristata Gmelin, at the Bot River Estuary, South Africa: A Preliminary Investigation,
W89-00662 2L

Comparison of the Physiological Condition of the Southern Mullet Liza richardsoni (Smith), in a Closed Estuary and the Sea,
W89-00663 2L

Mass Mortality of Fish Associated with Low Salinity Conditions in the Bot River Estuary,
W89-00664 2L

Changes in the Fish Fauna of the Bot River Estuary in Relation to Opening and Closure of the Estuary Mouth,
W89-00665 2L

Synopsis of the Impact of Artificially Opening the Mouth of the Bot River Estuary: Implications for Management,
W89-00666 2L

CARNEGIE INSTITUTION OF WASHINGTON, BALTIMORE, MD. DEPT. OF EMBRYOLOGY.
Comparative Sensitivities of Bluegill, Channel Catfish and Fathead Minnow to pH and Aluminum,
W89-01098 5C

CASCADES VOLCANO OBSERVATORY, VANCOUVER, WA.
Formation and Failure of Natural Dams,
W89-00470 2J

CASE WESTERN RESERVE UNIV., CLEVELAND, OH. DEPT. OF SYSTEMS ENGINEERING.
Analytical Simulation of Water System Capacity Reliability: 1. Modified Frequency-Duration Analysis,
W89-01240 5F

Analytical Simulation of Water System Capacity Reliability: 2. A Markov Chain Approach and Verification of the Models,
W89-01241 5F

CASWELL, EICHLER AND HILL, INC., WEST TOPSHAM, VT.
Esker Aquifers,
W89-00264 4B

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Waste Allocation Simulation Models,
W89-01234 5D

CENTER FOR INFECTIOUS DISEASES, ATLANTA, GA. HOSPITAL INFECTIONS PROGRAM.
Efficacy of Chemical Dosing Methods for Isolating Nontuberculous Mycobacteria from Water Supplies of Dialysis Centers,
W89-00343 5A

CENTRAL CHINA TEACHER'S UNIV., WUCHANG (CHINA).
Study of Modern Vicissitudes of the Jianghan Lake Group by Using Remote Sensing Techniques,
W89-00542 2H

CENTRAL ELECTRICITY GENERATING BOARD, LEATHERHEAD (ENGLAND). CENTRAL ELECTRICITY RESEARCH LABS.
Other Forms of Environmental Pollution,
W89-00794 5B

CENTRAL MARINE FISHERIES RESEARCH INST., CALCUTTA (INDIA).
Improving Canal Water Deliveries with Auxiliary Storage,
W89-00758 3B

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Effects of Rate Structure Knowledge on Household Water Use,
W89-00877 6D

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Simplified Turbine Runner Shows Good Cavitation Resistance,
W89-01003 8C

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Dissolved Mercury Behaviour in the Saint Lawrence Estuary,
W89-00285 5B

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Estimation of Bare Soil Evaporation from Airborne Measurements,
W89-00352 7B

CENTRE NATIONAL DU MACHINISME AGRICOLE, DU GENIE RURAL, DES EAUX ET DES FORETS, ANTONY (FRANCE). DIV. DRAINAGE ET ASSAINISSEMENT AGRICOLES.
Subsurface Drainage Peak Flows in Shallow Soil,
W89-00749 4A

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Heavy Metal Pollution in the Guadiamar River and the Guadalquivir Estuary (South West Spain),
W89-00573 5B

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Runoff Generation in a Plough-drained Peat Bog in Southern Scotland,
W89-00345 4C

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Southwest Branch of the North American Monsoon During Summer 1979,
W89-00845 2A

CESKOSLOVENSKA AKADEMIE VED, TREBON. DEPT. OF HYDROBOTANY.
Patterns of Temperature and Humidity in Wetland Biotopes,
W89-00124 2H

Evapotranspiration of a Willow Carr in Summer,
W89-00125 2D

CHALMERS UNIV. OF TECHNOLOGY, GOETEBORG (SWEDEN). DEPT. OF SANITARY ENGINEERING.
Size Distribution and Copper Association of Dissolved Organic Material in Urban Runoff,
W89-00628 5B

CHAUTAUQUA COUNTY DEPT. OF HEALTH, MAYVILLE, NY. DIV. OF ENVIRONMENTAL HEALTH SERVICES.
Source Protection and the Small Utility,
W89-01116 5G

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Purge and Trap Analysis of Aqueous Samples with Cryofocusing,
W89-00446 5A

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Determination of Probability Weighted Moments with the Incorporation of Extraordinary Values into Sample Data and Their Application to Estimating Parameters for the Pearson Type Three Distribution,
W89-01199 7C

CHICAGO-KENT COLL. OF LAW, IL.
Changing Meaning of Water Conservation in the West,
W89-01269 6E

CHILE UNIV., SANTIAGO. INST. DE NUTRICION DE LOS ALIMENTOS.
Animal Wastes Media for Spirulina Production,
W89-00136 5D

CHINA INTERNATIONAL ENGINEERING CONSULTING CORP., CHANGSHA (CHINA).
Dongjiang: A 500 MW Hydro Plant for Hunan Province,
W89-01001 8C

CHINESE ACADEMY OF ENVIRONMENTAL SCIENCES, BEIJING.
Application of the Principle of Least Sigma to the Chemical Model of Natural Water, (in Chinese),
W89-00537 2H

CHUGOKU REGIONAL CONSTRUCTION BUREAU OFFICIALS RELIEF ASSOCIATION, ENYA (JAPAN).
Studies on Formations and Changes of Micro-Stratification in Blackish Water Lake Shinji, (in Japanese),
W89-00772 2H

CINCINNATI UNIV., OH. DEPT. OF CIVIL AND ENVIRONMENTAL ENGINEERING.
Leaching of Inorganic Hazardous Constituents from Stabilized/Solidified Hazardous Wastes,
W89-00999 5E

CITADEL, CHARLESTON, SC.
Great Lakes Shore Erosion,
W89-00133 4D

CLARK UNIV., WORCESTER, MA. GRADUATE SCHOOL OF GEOGRAPHY.
Groundwater Rights: Definition and Transfer,
W89-00838 6E

CLARKSON UNIV., POTSDAM, NY. DEPT. OF CIVIL AND ENVIRONMENTAL ENGINEERING.
Drainage Basin Control of Acid Loadings to Two Adirondack Lakes,
W89-00710 5B

Factors Affecting the Efficiency of Some Estimates of Fluvial Total Phosphorus Load,
W89-01249 5B

CLEMSON UNIV., SC. DEPT. OF ENVIRONMENTAL SYSTEMS ENGINEERING.
Method to Assess Periodic Responses of Aquatic Microecosystems to Photosynthetic Inhibition,
W89-00562 7B

CLEMSON UNIV., SC. DEPT. OF MICROBIOLOGY.
Populations of Anaerobic Phototrophic Bacteria in a Spartina alterniflora Salt Marsh,
W89-00333 2L

CLEVELAND STATE UNIV., OH. DEPT. OF GEOLOGICAL SCIENCES.
Performance of Vinyl Core Media Trickling Filter Plant for Secondary Treatment of Municipal Wastewater,
W89-00502 5D

CLYDE RIVER PURIFICATION BOARD, EAST KILBRIDE (SCOTLAND).
Fresh Water Inflows to the Firth of Clyde,
W89-00801 2L

Effluent Disposal and the Physical Environment,
W89-00804 5E

Status of Fish Populations in the Clyde Estuary,
W89-00809 2L

Trace Metals in the Common Mussel Mytilus edulis (L.) in the Clyde Estuary,
W89-00823 5B

Use of the Clyde Estuary and Firth for the Disposal of Effluents,
W89-00824 5E

Migratory Salmonids of the Estuary and Firth of Clyde,
W89-00828 5G

COLD REGIONS RESEARCH AND ENGINEERING LAB., HANOVER, NH.
Evaluation of Disposable Membrane Filter Units for Sorptive Losses and Sample Contamination,
W89-00623 5A

COLORADO COLL., COLORADO SPRINGS. DEPT. OF CHEMISTRY.
Liquid Cloudwater Collection Using Modified Mohnen Slotted Rods,
W89-00764 7B

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF AGRICULTURAL AND CHEMICAL ENGINEERING.
Improved Methodology for a Collinear Dual-Energy Gamma Radiation System,
W89-00985 7B

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF CIVIL ENGINEERING.
Laboratory Analysis of Mudflow Properties,
W89-00899 2J

Suspension of Large Concentrations of Sands,
W89-00900 2J

COLORADO UNIV. AT BOULDER. DEPT. OF ENVIRONMENTAL, POPULATION, AND ORGANISMIC BIOLOGY.
Primary Production in the Orinoco River,
W89-00907 2H

COLORADO UNIV. AT BOULDER. DEPT. OF GEOLOGICAL SCIENCES.
Aragonite-to-Calcite Transformation During Fresh-Water Diagenesis of Carbonates: Insights from Pore-Water Chemistry,
W89-01076 2K

COLUMBIA NATIONAL FISHERIES RESEARCH LAB., MO.
Sensitivity of Young Striped Bass to Organic and Inorganic Contaminants in Fresh and Saline Waters,
W89-00320 5C

Waste Transformer Oil and PCB Toxicity to Rainbow Trout,
W89-00328 5C

Leaching of Retorted Oil Shale: Assessing the Toxicity to Colorado Squawfish, Fathead Minnows, and Two Food-Chain Organisms,
W89-00329 5C

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Secondary Ice Nucleus Generation by Silver Iodide Applied to the Ground,
W89-00088 3B

Persistent Effects of Cloud Seeding with Silver Iodide,
W89-00091 3B

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, CANBERRA (AUSTRALIA). DIV. OF ENVIRONMENTAL MECHANICS.
Steady Unsaturated Seepage above a Sloping Impermeable Base,
W89-00726 2G

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, HOBART (AUSTRALIA). MARINE LABS.
Interannual Variability in Climate and Fisheries in Tasmania,
W89-00847 2A

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, INDOOROOPILLY (AUSTRALIA). DIV. OF ENTOMOLOGY.
Chemical Environment of Salvinia molesta Mitchell: Ionic Concentrations of Infested Waters,
W89-00106 5B

Nitrogen, Phosphorus and Potassium in Salvinia molesta Mitchell in the Field: Effects of Weather, Insect Damage, Fertilizers and Age,
W89-00113 2H

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, INDOOROOPILLY (AUSTRALIA). LONG POCKET LABS.
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W89-00111 2H

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, WEMBLEY (AUSTRALIA). DIV. OF WATER RESOURCES.
Landscape and Rainfall Indices for Prediction of Streamflow Similarities in the Hunter Valley, Australia,
W89-00972 2E

Tracing of Water Movement in the Unsaturated Zone Using Stable Isotopes of Hydrogen and Oxygen,
W89-01016 2G

Role of Soil Organic Matter in the Geochemical Cycling of Chloride and Bromide,
W89-01200 2A

COMPAGNIE GENERALE DES EAUX, NICE (FRANCE).
Optimization of the Production and Pumping Costs of the Nice Water Network (Optimisation de la Production et des Pompages sur le Reseau d'Eau de Nice),
W89-00922 5F

CONSERVATION DE LA FAUNE, SAINT-SULPICE (SWITZERLAND).
Eutrophication and Benthic Fauna of Three Mountain Lakes (Eutrophisation et Faune Benthique de Trois Lacs de Montagne),
W89-00695 5C

CONSIGLIO NAZIONALE DELLE RICERCHE, BOLOGNA (ITALY). IST. PER LA GEOLOGIA MARINA.
Sequential Extraction of Phosphorus and Heavy Metals from Sediments: Methodological Considerations,
W89-00629 5A

Sediment-Water Core Sampler for Coastal Pollution Studies,
W89-00641 5A

CONSTRUCTION ENGINEERING RESEARCH LAB. (ARMY), CHAMPAIGN, IL.
Quality Control Approach to NPDES Compliance Determination,
W89-01136 5D

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Immobilization of Leachable Toxic Soil Pollutants by Using Oxidative Enzymes,
W89-00341 5G

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Basic Encoded Model for One-Dimensional Ground Water Systems Incorporating First-Order Degradation Kinetics,
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High Rates of Production and Mortality of Submerged Sparganium emersum Rehman during Its Short Growth Season in a Eutrophic Danish Stream,
W89-00099 2H

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Sorption and Degradation of Aldicarb and Its Oxidation Products in a Soil-Water Flow System as a Function of pH and Temperature,
W89-01164 5B

CORNELL UNIV., ITHACA, NY. SCHOOL OF CIVIL AND ENVIRONMENTAL ENGINEERING.
Compressible Cake Filtration: Monitoring Cake Formation and Shrinkage Using Synchrotron X-rays,
W89-00512 5D

CREVE COEUR DEPT. OF PUBLIC WORKS, MO.
Lake Dredging Boosts Recreational and Esthetic Environments,
W89-00468 5G

CSONGRAD COUNTY PUBLIC HEALTH STATION, SZEGED (HUNGARY).
Water Quality of the Tisza River and the Alpar Backwater,
W89-00143 5B

CUNO, MERIDEN, CT.
Microporous Filters with Oxidizing Power for Iron and Manganese Removal from Water,
W89-00889 5F

CWC-HDR, INC., CAMERON PARK, CA.
Filtration Technologies for Water Treatment,
W89-01099 5F

DAILY ANALYTICAL LAB., PEORIA, IL.
Macroinvertebrate Populations in a Thermally Impacted Reservoir,
W89-00397 5C

DALLAS CITY WATER UTILITIES DEPT., TX.
Water Pollution Control in Dallas-Fort Worth,
W89-01233 5G

DEAKIN UNIV., MELBOURNE (AUSTRALIA). DIV. OF CHEMICAL AND PHYSICAL SCIENCES.
Instrumentation for 7-Day Continuous Cycle Monitoring of Metals with Automated On-Line Sample Preparation, High-Performance Liquid Chromatography, and Electrochemical Detection,
W89-00210 5A

DELAWARE UNIV., LEWES. COLL. OF MARINE STUDIES.
Atmospheric Deposition of Arsenic and Association with Acid Precipitation,
W89-00431 5B

Estimating Bacterial Production in Marine Waters from the Simultaneous Incorporation of Thymidine and Leucine,
W89-00729 7B

Dispersal and Recruitment of Fiddler Crab Larvae in the Delaware River Estuary,
W89-01039 2L

DELTA INST. FOR HYDROBIOLOGICAL RESEARCH, YERSEKE (NETHERLANDS).
Phytoplankton Composition of Stagnant and Tidal Ecosystems in Relation to Salinity, Nutrients, Light and Turbulence,
W89-00001 2L

Distribution, Dynamics and Productivity of a Colonizing (Polydora quadrilobata) and an Established (P. ligni) Polydorid Polychaete in Lake Grevelingen: An Enclosed Estuary in the SW Netherlands,
W89-00002 2H

Evaluation of Seasonal Nutrient Dynamics in the Oosterschelde (SW Netherlands),
W89-00153 2L

Decomposition of Roots of Three Plant Communities in a Dutch Salt Marsh,
W89-00527 2L

Comparison of Methods for the Determination of Chlorophyll in Estuarine Sediments,
W89-00668 2L

Partitioning of Organochlorines Between Water, Particulate Matter and Some Organisms in Estuarine and Marine Systems of the Netherlands,
W89-00672 5B

DEMOKRITOS UNIV. OF THRACE, KOMOTINI (GREECE).
Ecological Parameter of Surface Water in Northeastern Greece,
W89-00564 5B

DENVER UNIV., CO. COLL. OF LAW.
Survey of the International Law of Rivers,
W89-00835 6E

DEPARTMENT OF AGRICULTURE, OTTAWA (ONTARIO). LAND RESOURCE RESEARCH INST.
Multiple Reflection and Attenuation of Time Domain Reflectometry Pulses: Theoretical Considerations of Applications to Soil and Water,
W89-00701 7B

Determination of Electrical Conductivity Using Time Domain Reflectometry: Soil and Water Experiments in Coaxial Lines,
W89-00702 2G

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Estimating the Acute Toxicity of Waterborne Chemicals in Trout from Measurements of Median Lethal Dose and the Octanol-Water Partition Coefficient,
W89-01095 5C

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Disruption of the Nitrogen Cycle in Acidified Lakes,
W89-00451 5C

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Legionnaire's Disease in a Johannesburg Teaching Hospital,
W89-00450 5F

DEPARTMENT OF NATURE AND ENVIRONMENTAL CONSERVATION, STELLENBOSCH (SOUTH AFRICA).
Variations in the Use of the Bot River Estuary by Water-Birds,
W89-00661 2L

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W89-00659 2L

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W89-01029 6D

DESERT ECOLOGICAL RESEARCH UNIT, NAMIBIA (SOUTH AFRICA).
Predictability of Two Moisture Sources in the Namib Desert,
W89-00455 2B

DETOX, INC., DAYTON, OH.
Treatment of Herbicides in Ground Water,
W89-00938 5F

DEUTSCHE GESELLSCHAFT FUER TECHNISCHE ZUSAMMERNARBEIT G.M.B.H., ESCHBORN (GERMANY, F.R.). WATER PURIFICATION PROJECT.
Using Moringa Seeds as Coagulants in Developing Countries,
W89-00420 5F

DIREKTORATET FOR VILT OG FERSKVANNSFISK, AAS (NORWAY). FISH RESEARCH DIV.
Limnocorral Experiments in a Eutrophic Lake - Effects of Fish on the Planktonic and Chemical Conditions,
W89-00253 2H

DORTMUND UNIV. (GERMANY, F.R.). FACHBEREICH CHEMIE.
Evaluation of the Sulfur(IV) Catalyzed Autoxidation of Cobalt(II) in an Azide Containing Medium as a Means for the Determination of Sulfite in Precipitation,
W89-00736 5A

DUKE POWER ENVIRONMENTAL LABS., HUNTERSVILLE, NC.
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W89-00187 2H

DUKE UNIV., DURHAM, NC. DEPT. OF CIVIL AND ENVIRONMENTAL ENGINEERING.
Movement of Sludge through Conveyor Centrifuge,
W89-00485 5D

DUKE UNIV., DURHAM, NC. SCHOOL OF FORESTRY AND ENVIRONMENTAL STUDIES.
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W89-00713 5C

DUNDEE UNIV. (SCOTLAND). DEPT. OF BIOLOGICAL SCIENCES.
Development of Mass Blooms of Photosynthetic Bacteria on Sheltered Beaches in Scapa Flow, Orkney Islands,
W89-00795 2L

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Finite Element Computation of Shape Factors for Kirkham's Piezometer Tube Method for Hydraulic Conductivity of Saturated Soil,
W89-00911 2G

DUNSTAFFNAGE MARINE RESEARCH LAB., OBAN (SCOTLAND).
Clyde Sea Hydrography,
W89-00802 2L

Phytoplankton Ecology of the Firth of Clyde Sea-Lochs Striven and Fyne,
W89-00813 2L

Long-Term Changes in Some Benthic Species in the Firth of Clyde, with Particular Reference to Tellina tenuis da Costa,
W89-00817 5C

Biology of Harpacticoid Copepods in the Meiofauna of Shallow Subtidal Sands,
W89-00818 2L

Benthos of the Deeper Sediments of the Firth of Clyde, with Particular Reference to Organic Enrichment,
W89-00820 5C

EAST CAROLINA UNIV., GREENVILLE, NC. DEPT. OF BIOLOGY.
Biomass Production and Nutrient Cycling in Aquatic Macrophyte Communities of the Chowan River, North Carolina,
W89-00097 2H

EAST CHINA NORMAL UNIV., SHANGHAI.
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W89-00198 2H

EASTWOOD LOCAL SCHOOLS, PEMBERVILLE, OH.
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W89-00684 5A

ECO-TEC LTD., PICKERING (ONTARIO).
Copper, Nickel, and Chrome Recovery in a Jobshop to Eliminate Waste Treatment and Sludge Disposal,
W89-00993 5D

ECOLE POLYTECHNIQUE FEDERALE DE LAUSANNE (SWITZERLAND). DEPT. DE GENIE CIVIL.
Mobile Flume for Circular Channel,
W89-00757 7B

EIDGENOESSISCHE ANSTALT FUER WASSERVERSORGUNG, ABWASSERREINIGUNG UND GEWAESSERSCHULTZ, DUEBENDORF (SWITZERLAND).
Lake Restoration: Why Oxygenation and Artificial Mixing Cannot Substitute for a Decrease in the External Phosphorus Loading,
W89-00015 5G

Aliphatic and Polycyclic Aromatic Hydrocarbons in Urban Rain, Snow and Fog,
W89-00309 5B

Seasonal and Temporal Changes of Organic Compounds in Rain and Snow,
W89-00429 5B

Binding of Heavy Metals to Algal Surfaces,
W89-01227 5B

EIDGENOESSISCHE ANSTALT FUER WASSERVERSORGUNG, ABWASSERREINIGUNG UND GEWAESSERSCHULTZ, DUEBENDORF (SWITZERLAND). INST. OF AQUATIC SCIENCES.
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W89-00023 2H

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W89-00689 2K

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Aerosol and Hydrometeor Concentrations and Their Chemical Composition during Winter Precipitation along a Mountain Slope: I. Temporal Evolution of the Aerosol, Microphysical and Meteorological Conditions,
W89-01150 2B

EIDGENOESSISCHE TECHNISCHE HOCHSCHULE, ZURICH (SWITZERLAND). DEPT. OF CHEMICAL ENGINEERING.
Operation of a Three-Phase Biofilm Fluidized Sand Bed Reactor for Aerobic Wastewater Treatment,
W89-00747 5D

EIDGENOESSISCHE TECHNISCHE HOCHSCHULE, ZURICH (SWITZERLAND). INST. OF STRUCTURAL ENGINEERING.
Hydrodynamic-Stiffness Matrix Based on Boundary Elements for Time-Domain Dam-Reservoir-Soil Analysis,
W89-00447 8B

EIDGENOESSISCHE TECHNISCHE HOCHSCHULE, ZURICH (SWITZERLAND). VERSUCHSANSTALT FUER WASSERBAU, HYDROLOGIE UND GLAZIOLOGIE.
Records of Riverborne Turbidity Currents and Indications of Slope Failures in the Rhone Delta of Lake Geneva,
W89-01049 2J

ELECTRONIC TECHNIQUES, INC., AUBURN, CA.
Winter Diurnal Trends of Sierra Nevada Supercooled Liquid Water and Precipitation,
W89-00089 3B

EMPORIA STATE UNIV., KS. DEPT. OF CHEMISTRY.
Fate of Alachlor during Treatment of Public Water Supplies,
W89-00395 5F

ENGINEERING-SCIENCE, INC., ATLANTA, GA.
Effect of Culture History on the Determination of Biodegradation Kinetics by Batch and Fed-Batch Techniques,
W89-00513 5D

ENVIRONMENTAL MONITORING AND SUPPORT LAB.-CINCINNATI, OH. BIOLOGICAL METHODS BRANCH.
Evaluation and Comparison of Two Short-Term Fathead Minnow Tests for Estimating Chronic Toxicity,
W89-01224 5A

ENVIRONMENTAL PROTECTION AGENCY, ATHENS, GA. SOUTHEAST ENVIRONMENTAL RESEARCH LAB.
Reactivity of the Carbonate Radical with Aniline Derivatives,
W89-01088 5B

ENVIRONMENTAL PROTECTION AGENCY, CINCINNATI, OH.
Occurrence of Radon, Radium, and Uranium in Groundwater,
W89-01108 5B

ENVIRONMENTAL PROTECTION AGENCY, CINCINNATI, OH. DRINKING WATER RESEARCH DIV.
GAC Treatment Cost Experience at Two Drinking Water Utilities,
W89-00495 5F

Methods for Removing Uranium from Drinking Water,
W89-01110 5F

ENVIRONMENTAL PROTECTION AGENCY, CINCINNATI, OH. OFFICE OF RESEARCH AND DEVELOPMENT.
Contaminant Propagation in Distribution Systems,
W89-00494 5F

ENVIRONMENTAL PROTECTION AGENCY, CINCINNATI, OH. WATER ENGINEERING RESEARCH LAB.
Influence of Feeding Procedure on Microbial Reductions and Performance of Anaerobic Digestion,
W89-00511 5D

Modeling Contaminant Propagation in Drinking Water Distribution Systems,
W89-00929 5F

ENVIRONMENTAL PROTECTION AGENCY, GULF BREEZE, FL. GULF BREEZE ENVIRONMENTAL RESEARCH LAB.
Biotic and Abiotic Degradation Rates of Methyl Parathion in Freshwater and Estuarine Water and Sediment Samples,
W89-00601 5B

ENVIRONMENTAL PROTECTION AGENCY, WASHINGTON, DC.
Role of Economic Benefits Analysis in Funding Marine Combined Sewer Overflow Projects - Case Study of Boston Harbor,
W89-01132 6C

ENVIRONMENTAL PROTECTION AGENCY, WASHINGTON, DC. OFFICE OF POLICY, PLANNING AND EVALUATION.
Innovative Septic System Management,
W89-00508 5D

ENVIRONMENTAL PROTECTION SERVICE, BURLINGTON (ONTARIO). WASTE WATER TECHNOLOGY CENTRE.
Removal of Pentachlorophenol in Municipal Activated Sludge Systems,
W89-00509 5D

ENVIRONMENTAL RESEARCH LAB., ATHENS, GA.
Estimate of the Variability in Biotransformation Kinetics of Xenobiotics in Natural Waters by Aufwuchs Communities,
W89-00559 5B

Effects of Aquatic Humic Substances on Analysis for Hydrogen Peroxide Using Peroxidase-Catalyzed Oxidations of Triarylmethanes or p-Hydroxyphenylacetic Acid,
W89-00634 7B

ENVIRONMENTAL RESEARCH LAB.-DULUTH, MN.
Bioavailability of Polychlorinated Dibenzo-p-dioxins and Dibenzofurans from Contaminated Wisconsin River Sediment to Carp,
W89-00583 5B

Acute and Chronic Toxicity of Triphenyltin Hydroxide to Fathead Minnows (Pimephales promelas) Following Brief or Continuous Exposure,
W89-01057 5C

ERLANGEN-NUERNBERG UNIV., ERLANGEN (GERMANY, F.R.). INST. FUER BOTANIK ND PHARMAZEUTISCHE.
Limits of Growth of Five Chlorella Species in the Presence of Toxic Heavy Metals,
W89-00191 5C

ERM-SOUTHEAST, INC., ATLANTA, GA.
Use of Duckweed for Wastewater Treatment,
W89-01128 5D

ESSEX UNIV., COLCHESTER (ENGLAND). DEPT. OF BIOLOGY.
Survey of Mercury, Lead and Cadmium in Muscle of British Freshwater Fish,
W89-00587 5B

EXETER UNIV. (ENGLAND). DEPT. OF GEOGRAPHY.
Landsat-MSS Radiance as a Measure of Suspended Sediment in the Lower Yellow River (Hwang Ho),
W89-00065 7B

Recent Transport of Metals in the River Severn as Recorded by the Sediments of Chelmarsh Reservoir, Shropshire, U.K.,
W89-00885 5B

Erosion and Sediment Yield Research: Some Recent Perspectives,
W89-01015 2J

FERRARA UNIV. (ITALY). IST. DI ZOOLOGIA.
Trophic State Gradients and Zooplankton and Zoobenthos Distribution in a Po River Delta Lagoon,
W89-00580 2L

FIELD STUDIES COUNCIL, PEMBROKE (WALES). OIL POLLUTION RESEARCH UNIT.
Macrobenthos of the Beatrice Oilfield, Moray Firth, Scotland,
W89-00782 2L

Comparison of the Fauna Retained On 0.5 mm and 1.0 mm Meshes from Benthic Samples Taken in the Beatrice Oilfield, Moray Firth, Scotland,
W89-00783 2L

FINNISH PULP AND PAPER RESEARCH INST., HELSINKI.
High Molar Mass Lignin in Bleached Kraft Pulp Mill Effluents,
W89-00361 5A

Sublethal Effects of Chlorinated Phenols and Resin Acids on Rainbow Trout (Salmo gairdneri),
W89-00364 5C

Mutagenicity in Pulp and Paper Mill Effluents and in Recipient,
W89-00370 5C

FISH AND WILDLIFE SERVICE, ANCHORAGE, AK. ALASKA REGIONAL OFFICE.
Habitat Use of Two Darter Species in Glover River, Oklahoma,
W89-00396 2H

FISH AND WILDLIFE SERVICE, KEARNEYSVILLE, WV. EASTERN ENERGY AND LAND USE TEAM.
Does pH Affect Fish Species Richness when Lake Area is Considered,
W89-00324 2H

FLORIDA UNIV., GAINESVILLE. CENTER FOR AQUATIC WEEDS.
Effect of Gibberellic Acid and 2,4-D on Water Hyacinths,
W89-00105 4A

FLORIDA UNIV., GAINESVILLE. DEPT. OF AGRICULTURAL ENGINEERING.
Satellite Data and Geographical Information System for Land Use Classification,
W89-00756 7B

FLORIDA UNIV., GAINESVILLE. DEPT. OF ENVIRONMENTAL ENGINEERING SCIENCES.
Technology, Institutions, and Social Goals,
W89-00871 6D

FLORIDA UNIV., GAINESVILLE. DEPT. OF MICROBIOLOGY AND CELL SCIENCE.
Novel Approach for Modifying Microporous Filters for Virus Concentration from Water,
W89-00332 5A

FOOD AND DRUG BUREAU, TAIPEI (TAIWAN).
Routine Determination of Polychlorinated Biphenyl Residues in Fish and Shellfish in Taipei County,
W89-00605 5A

FORDHAM UNIV., BRONX, NY. SCHOOL OF LAW.
International Control of Cross-Media Pollution: An Ecosystem Approach,
W89-00520 5G

FOREST SERVICE, PORTLAND, OR. PACIFIC NORTHWEST RESEARCH STATION.
Bacterial Water Quality Responses to Four Grazing Strategies: Comparisons with Oregon Standards,
W89-01170 5B

FORT HAYS STATE UNIV., HAYS, KS. DEPT. OF EARTH SCIENCE.
Variations of Runoff in the High Plains Section of the Smoky Hill Drainage, 1951-1980,
W89-00394 2A

FRESHWATER BIOLOGICAL ASSOCIATION, AMBLESIDE (ENGLAND).
Channel Change and Sediment Transport in Regulated U.K. Rivers,
W89-00958 2J

FRESHWATER BIOLOGICAL ASSOCIATION, WAREHAM (ENGLAND). RIVER LAB.
Studies on Epilithic and Epiphytic Diatoms in a Chalkstream: Comparative Estimates of Chlorophyll a and Its Derivatives,
W89-01186 2H

FRESHWATER BIOLOGICAL ASSOCIATION, WINDERMERE (ENGLAND).
Internal Elemental Cycles Affecting the Long-Term Alkalinity Status of Lakes: Implications for Lake Restoration,
W89-00016 5G

Response of Phytoplankton Communities to Changing Lake Environments,
W89-00018 2H

Short-term Dynamics of a Melosira Population in the Plankton of an Impoundment in Central Chile,
W89-00214 2H

FRIDTJOF NANSEN INST., LYSAKER (NORWAY).
Sea Use Planning in Norwegian Waters: National and International Dimensions,
W89-00289 6E

GDANSK UNIV. (POLAND). DEPT. OF PLANT ECOLOGY AND NATURE PROTECTION.
Structure of a Population of Lobelia dortmanna L. Along a Gradient of Increasing Depth in an Oligotrophic Lake,
W89-00525 2H

Seasonal Development of Lobelia Dortmanna L. and Annual Balance of Its Population Size in an Oligotrophic Lake,
W89-00526 2H

GENERAL CHEMICAL CORP., SYRACUSE, NY.
Lake Treatment with Alum,
W89-00745 5G

GENERAL HYDROLOGICAL STATION OF ANHUI PROVINCE (CHINA).
Assessing the Influence of Environmental Parameters on the Hydrological Cycle,
W89-00916 2A

GENERAL HYDROLOGICAL STATION OF LIAONING PROVINCE, SHENYANG (CHINA).
Composite Method for Estimating Annual Actual Evapotranspiration,
W89-01141 2D

GENERAL MOTORS RESEARCH LABS., WARREN, MI. ENVIRONMENTAL SCIENCE DEPT.
Statistical Correlations for Predicting the Partition Coefficient for Nonpolar Organic Contaminants Between Aquifer Organic Carbon and Water,
W89-00992 5B

GENOA UNIV. (ITALY). INST. OF HYDRAULICS.
Multivariate Periodic ARMA (1,1) Processes,
W89-00967 7B

GEOLOGICAL SURVEY, ALTAMONTE SPRINGS, FL.
Effectiveness of an Urban Runoff Detention Pond-Wetlands System,
W89-00487 5G

GEOLOGICAL SURVEY, AUSTIN, TX. WATER RESOURCES DIV.
Eutrophication of Lakes and Reservoirs: A Framework for Making Management Decisions,
W89-00439 5C

GEOLOGICAL SURVEY, DENVER, CO.
Regression Estimates for Topological-Hydrograph Input,
W89-00304 2E

Creosote Compounds in Snails Obtained from Pensacola Bay, Florida, near an Onshore Hazardous-Waste Site,
W89-00611 5B

GEOLOGICAL SURVEY, LAKEWOOD, CO.
Experimental Marvin Windshield Effects on Precipitation Records in Leadville, Colorado,
W89-00876 7B

GEOLOGICAL SURVEY, NASHVILLE, TN.
Dry Stream Reaches in Carbonate Terranes: Surface Indicators of Ground-Water Reservoirs,
W89-00870 7B

GEOLOGICAL SURVEY OF SOUTH AFRICA, BELLVILLE.
Geomorphology, Offshore Bathymetry and Quaternary Lithostratigraphy around the Bot River Estuary,
W89-00649 2L

GEOLOGICAL SURVEY, RESTON, VA.
Effects of Grazers and Light Penetration on the Survival of Transplants of Vallisneria americana Michx in the Tidal Potomac River, Maryland,
W89-00108 2H

Effect of Sediment Depth and Sediment Type on the Survival of Vallisneria americana Michx Grown from Tubers,
W89-00114 2H

Statistical Methods and Sampling Design for Estimating Step Trends in Surface-Water Quality,
W89-00862 7A

Trends in Lead Concentrations in Major U.S. Rivers and Their Relation to Historical Changes in Gasoline-Lead Consumption,
W89-00868 5B

Groundwater Flow and Transport Modeling,
W89-01025 2F

GEOLOGICAL SURVEY, ROLLA, MO. WATER RESOURCES DIV.
Comparison of Instream and Laboratory Methods of Measuring Sediment Oxygen Demand,
W89-00869 7B

GEORGIA UNIV., ATHENS. DEPT. OF AGRONOMY.
Effect of Sodium Nitrate and Gypsum on Infiltration and Erosion of a Highly Weathered Soil,
W89-00409 2G

GEORGIA UNIV., ATHENS. DEPT. OF MICROBIOLOGY.
Adaptation of Phytoplankton-Degrading Microbial Communities to Thermal Reactor Effluent in a New Cooling Reservoir,
W89-00336 5C

GEORGIA UNIV., SAPELO ISLAND. MARINE INST.
Effect of pH and Contact Time on the Concentration of As(III) and As(V) in Coal Ash Systems,
W89-00624 5E

GESAMTHOCHSCHULE PADERBORN (GERMANY, F.R.). DEPT. OF APPLIED CHEMISTRY.
Determination of Phenoxy Acid Herbicides in Water Samples,
W89-00576 5A

GESELLSCHAFT FUER STRAHLEN- UND UMWELTFORSCHUNG M.B.H. MUENCHEN, NEUHERBERG (GERMANY, F.R.).
Frequent and Important Consequences from Increased Amounts of Liquid Manure (Haeufige und Wichtige Folgen Vermehrten Guelleanfalls),
W89-00500 5B

GESELLSCHAFT FUER STRAHLEN- UND UMWELTFORSCHUNG M.B.H. MUENCHEN, NEUHERBERG (GERMANY, F.R.). INST. FUER OEKOLOGISCHE CHEMIE.
Formation of Oxygen Species and Their Reactions with Organic Chemicals in Aqueous Solution,
W89-00575 5B

Influence of Chemicals upon Plankton in Freshwater Systems,
W89-00581 5C

GLASGOW UNIV. (SCOTLAND). DEPT. OF BOTANY.
Seasonal Studies on the Phytoplankton and Primary Production in the Inner Firth of Clyde,
W89-00812 2L

GLASGOW UNIV. (SCOTLAND). DEPT. OF GEOGRAPHY.
Geography of the Estuary and Firth of Clyde,
W89-00798 2L

Geological and Geomorphological Setting of the Estuary and Firth of Clyde,
W89-00799 2L

GLASGOW UNIV. (SCOTLAND). DEPT. OF ZOOLOGY.
Bioturbation, Microbial Activity and Sediment Properties in an Estuarine Ecosystem,
W89-00806 2L

Recent Changes in Numbers of Waders on the Clyde Estuary, and Their Significance for Conservation,
W89-00810 5C

Population Dynamics of Seabirds in the Firth of Clyde,
W89-00822 2L

GOETEBORG UNIV. (SWEDEN). DEPT. OF MARINE BOTANY.
Influence of Microphytobenthos on the Nutrient Flux between Sediment and Water: A Laboratory Study,
W89-01036 2L

GOETEBORG UNIV. (SWEDEN). TJARNO MARINE BIOLOGICAL LAB.
Interspecific, Seasonal and Diel Variations in Zooplankton Trypsin and Amylase Activities in Kosterfjorden, Western Sweden,
W89-01040 2L

GORAKHPUR UNIV. (INDIA). DEPT. OF ZOOLOGY.
Impact of Manganese Intoxication on the Blood Pyruvic Acid of a Freshwater Tropical Perch Colisa fasciatus,
W89-00263 5A

GOVERNMENT ARTS COLL., ARIYALUR (INDIA). DEPT. OF ZOOLOGY.
Effects of Lindane and Atropine Sulphate on the Tissues of the Fish, Anabas testudineus (Bloch): A Chronotoxicological Approach,
W89-00594 5C

GOVERNMENT INDUSTRIAL DEVELOPMENT LAB., SAPPORO (JAPAN).
Mechanism of Inactivation of Tobacco Mosaic Virus with Ozone,
W89-01229 5F

GRANADA UNIV. (SPAIN). DEPT. OF MICROBIOLOGY.
Characteristics of Soil after Pollution with Waste Waters from Olive Oil Extraction Plants,
W89-00602 5C

GREAT SALT BAY EXPERIMENTAL STATION, DAMARISCOTTA, ME.
Risk Analysis for Fish Diversion Experiments: Pumped Intake Systems,
W89-00318 8I

GRETNA, LA.
How Safe is Your Water Plant,
W89-00462 5F

GRIFFITH UNIV., NATHAN (AUSTRALIA). SCHOOL OF AUSTRALIAN ENVIRONMENTAL STUDIES.
Air and Water Flow: I. Horizontal Flow with an Arbitrary Flux Boundary Condition,
W89-00347 2G

Air and Water Flow: II. Gravitational Flow with an Arbitrary Flux Boundary Condition,
W89-00348 2G

Sediment-Water Partition Coefficients and HPLC Retention Factors of Aromatic Hydrocarbons,
W89-00560 5B

GRONINGEN RIJKSUNIVERSITEIT (NETHERLANDS). DEPT. OF MARINE BIOLOGY.
Population Dynamics of a Tropical Intertidal and Deep-Water Population of Sargassum polyceratium (Phaeophyceae),
W89-00528 2L

GROVELAND COMMUNITY SERVICES DISTRICT, CA.
Water/Wastewater Facilities Get Better with Electronics,
W89-00392 5D

GULF COAST RESEARCH LAB., OCEAN SPRINGS, MS.
Lignin Residues as Tracers of Organic Waste Transport,
W89-00561 7B

HACETTEPE UNIV., ANKARA (TURKEY). DEPT. OF HYDROGEOLOGICAL ENGINEERING.
MODALP: A Deterministic Rainfall-Runoff Model for Large Karstic Areas,
W89-01145 2F

HAJDU-BIHAR COUNTY WATER CANALIZATION WORKS, DEBRECEN (HUNGARY).
New Aspects of the Sulfur Cycle, with Special Reference to Shallow Waters,
W89-00183 5B

HAMBURG UNIV. (GERMANY, F.R.). GEOLOGISCH-PALAEONTOLOGISCHES INST. UND MUSEUM.
Ca(+2)-Stress, Biological Response and Particle Aggregation in the Aquatic Habitat,
W89-00669 2K

HAMBURG UNIV. (GERMANY, F.R.). INST. FUER HYDROBIOLOGIE UND FISCHEREIWISSENSCHAFT.
Role of Marsh Plants in the Transport of Nutrients as Shown by a Quantitative Model for the Freshwater Section of the Elbe Estuary,
W89-00120 2L

Diurnal Distribution and Behavioral Responses of Fishes to Extreme Hypoxia in an Amazon Floodplain Lake,
W89-00331 2H

HARVARD UNIV., CAMBRIDGE, MA. DIV. OF APPLIED SCIENCES.
Solubility of Colloidal Ferric Hydroxide and its Relevance to Iron Concentrations in River Water,
W89-01081 2K

HAWAII UNIV. AT HILO. DIV. OF NATURAL SCIENCES.
Distribution of Arsenic in the Sediments and Biota of Hilo Bay, Hawaii,
W89-00677 5B

HAWAII UNIV. AT MANOA, HONOLULU. DEPT. OF AGRONOMY AND SOIL SCIENCE.
Sewage Sludge-Soil Interactions as Measured by Plant and Soil Chemical Composition,
W89-01161 5E

Possible Mechanism for Manganese Phytotoxicity in Hawaii Soils Amended with a Low-Manganese Sewage Sludge,
W89-01169 5E

HAWAII UNIV. AT MANOA, HONOLULU. DEPT. OF GEOLOGY AND GEOPHYSICS.
Impact of Rainfall and Soil Hydraulic Property Information on Runoff Predictions at the Hillslope Scale,
W89-01246 2E

HAWAII UNIV., HONOLULU. DEPT. OF METEOROLOGY.
Life Cycle Effects of Cloud Clusters on the Moisture Distribution over the Eastern Atlantic,
W89-00417 2B

HAWAII UNIV., HONOLULU. DEPT. OF OCEANOGRAPHY.
Effects of Polyculture and Manure Fertilization on Water Quality and Heterotrophic Productivity in Macrobrachium rosenbergii Ponds,
W89-00327 8I

HEALTH EFFECTS RESEARCH LAB., CINCINNATI, OH.
Detection of Environmental Viruses in Sludge: Enhancement of Enterovirus Plaque Assay Titers with 5-Iodo-2'-Deoxyuridine and Comparison to Adenovirus and Coliphage Titers,
W89-01220 5A

HEBREW UNIV. OF JERUSALEM (ISRAEL). SCHOOL OF PUBLIC HEALTH.
Association Between Seawater Pollution as Measured by Bacterial Indicators and Morbidity Among Bathers at Mediterranean Bathing Beaches of Israel,
W89-00579 5C

HEIDELBERG COLL., TIFFIN, OH. WATER QUALITY LAB.
Snail Distributions in Lake Erie: The Influence of Anoxia in the Southern Central Basin Nearshore Zone,
W89-00683 2A

HELSINKI UNIV. (FINLAND). DEPT. OF ENVIRONMENTAL SCIENCE.
Leaching of Mercury from Peat Soil,
W89-00592 5B

HERIOT-WATT UNIV., EDINBURGH (SCOTLAND). DEPT. OF BIOLOGICAL SCIENCES.
Distribution of Plaice Eggs and Larvae in the Clyde Sea Area,
W89-00829 2L

HERIOT-WATT UNIV., EDINBURGH (SCOTLAND). DEPT. OF BREWING AND BIOLOGICAL SCIENCES.
Attached Algae of the Clyde and Garnock Estuaries,
W89-00807 5C

HEWLETT-PACKARD CO., AVONDALE, PA. AVONDALE DIV.
Comparing Headspace with Purge and Trap for Analysis of Volatile Priority Pollutants,
W89-01119 5A

HIGHLAND RIVER PURIFICATION BOARD, DINGWALL (SCOTLAND).
Sub-Littoral Fauna of the Inverness, Cromarty and Dornoch Firths,
W89-00784 2L

Regulation of Pollution: Controls and Responsibilities,
W89-00786 6E

Water Quality in the Inverness and Beauly Firths,
W89-00789 5B

Hydrocarbon and Pollutant Levels in the Cromarty Firth,
W89-00791 5B

HITACHI RESEARCH LAB. (JAPAN).
Phosphorus Removal by Crystallization Using a Granular Activated Magnesia Clinker,
W89-01126 5D

HNU SYSTEMS, INC., NEWTON, MA.
Analysis of ppb Levels of Organics in Water by Means of Purge-and-Trap, Capillary Gas Chromatography and Selective Detectors,
W89-00288 5A

HOHENHEIM UNIV., STUTTGART (GERMANY, F.R.). INST. FUER BODENKUNDE UND STANDORTSLEHRE.
Scanning Electron Microscopy of Bacteria and Diatoms Attached to a Submerged Macrophyte in an Increasingly Polluted Stream,
W89-00132 5C

HOKKAIDO UNIV., HAKODATE (JAPAN). FACULTY OF FISHERIES.
Distribution of Cadmium in Lake Tohya,
W89-00774 2H

HOKKAIDO UNIV., SAPPORO (JAPAN). DEPT. OF CHEMISTRY.
Theoretical Evaluation of Water Oligomer Populations in the Earth's Atmosphere,
W89-00763 2B

HOUSTON UNIV. AT CLEAR LAKE CITY, TX. BUREAU OF RESEARCH.
Risk: A Key Water Policy Issue,
W89-01123 6D

HOUSTON UNIV., TX. DEPT. OF CIVIL AND ENVIRONMENTAL ENGINEERING.
Evaluating Various Adsorbents and Membranes for Removing Radium from Groundwater,
W89-01109 5F

HOUSTON UNIV., TX. DEPT. OF CIVIL ENGINEERING.
Earthquake Response of Submerged Circular Arch,
W89-00306 8A

HOUSTON UNIV., TX. ENVIRONMENTAL ENGINEERING PROGRAM.
Determination of Microbial Kinetic Coefficients through Measurement of Initial Rates by Radiochemical Techniques,
W89-01218 5D

HSQ TECHNOLOGY, INC., SAN FRANCISCO, CA.
Making the Right Moves in SCADA Selection,
W89-01103 5F

HULL UNIV. (ENGLAND). DEPT. OF GEOLOGY.
Sediment Transport and Bed Morphology at River Channel Confluences,
W89-00411 2J

HUMBOLDT-UNIV. ZU BERLIN (GERMAN D.R.). MUSEUM FUR NATURKUNDE.
Toxicity of an Anionic Detergent to the Spawn and Larvae of Anurans (Amphibia),
W89-00139 5C

Sensitivity of Coral Reefs to Environmental Pollution,
W89-00440 5C

HUNAN MEDICAL COLL., CHANGSHA (CHINA). DEPT. OF ENVIRONMENTAL MEDICINE.
Trace Element Content in Drinking Water of Nasopharyngeal Carcinoma Patients,
W89-00048 5C

HUNGARIAN NATURAL HISTORY MUSEUM, BUDAPEST. BOTANICAL DEPT.
Role of Storms in the Summer Succession of the Phytoplankton Community in a Shallow Lake (Lake Balaton, Hungary),
W89-00232 2H

HUNTON AND WILLIAMS, NORFOLK, VA.
Toxic and Environmental Torts within Admiralty,
W89-00518 6E

HYDROLAB CORP., AUSTIN, TX.
Making the Most of Field-Measurable Ground Water Quality Parameters,
W89-00939 7B

HYDROLOGICAL RESEARCH INST., PRETORIA (SOUTH AFRICA).
Determination of Phosphate at Low Concentrations in Surface Waters by Flow-Injection Analysis,
W89-00931 5A

HYDROMETEOROLOGICAL INST. OF CROATIA, ZAGREB (YUGOSLAVIA).
Principal Component Analysis of Precipitation in the Adriatic-Pannonian Area of Yugoslavia,
W89-00472 2B

HYDROMETEROLOGICAL EXPERIMENT STATION OF POYANG LAKE, XINGZI (CHINA).
Hydrological Features of Poyang Lake, (in Chinese),
W89-00532 2H

Hydrological Features of Poyang Lake (II), (in Chinese),
W89-00535 2H

IDAHO DIV. OF ENVIRONMENT, POCATELLO.
Diel and Seasonal Carbon Budgets in Two Cold Spring Ecosystems,
W89-00177 2H

IDAHO UNIV., MOSCOW. DEPT. OF CIVIL ENGINEERING.
Annual Flow Statistics for Ungaged Streams in Idaho,
W89-00753 7C

ILLINOIS INST. OF TECH., CHICAGO. DEPT. OF ENVIRONMENTAL ENGINEERING.
Effects of Discontinuing Disinfection on a Receiving Water,
W89-00515 5D

ILLINOIS INST. OF TECH., CHICAGO. PRITZKER DEPT. OF ENVIRONMENTAL ENGINEERING.
Micromixing and Dispersion in Chlorine Contact Chambers,
W89-00622 5D

Gravimetric Measurement of Adsorption Parameters in Water Systems with a Quartz Spring Balance,
W89-01216 5A

ILLINOIS STATE WATER SURVEY, CHAMPAIGN. SURFACE WATER SECTION.
Long-Term Ecological Research on Illinois Rivers,
W89-00401 2H

ILLINOIS STATE WATER SURVEY DIV., CHAMPAIGN.
Scour Channel Development after Spillway Failure,
W89-00897 2J

ILLINOIS STATE WATER SURVEY DIV., CHAMPAIGN. AQUATIC CHEMISTRY SECTION.
Oxygen Transfer Through Flexible Tubing and Its Effects on Ground Water Sampling Results, W89-00943 5A

ILLINOIS STATE WATER SURVEY, PEORIA. WATER QUALITY SECTION.
Experiences of Long-term Destratification in a Water Supply Impoundment in Central Illinois, W89-00403 5G

ILLINOIS UNIV. AT URBANA-CHAMPAIGN. DEPT. OF AGRICULTURAL ENGINEERING.
Evaluating Peat-Mining Hydrology Using DRAINMOD, W89-00755 4C

ILLINOIS UNIV. AT URBANA-CHAMPAIGN. DEPT. OF CIVIL ENGINEERING.
Method for Locating Wells in a Groundwater Monitoring Network Under Conditions of Uncertainty, W89-00971 7A

ILLINOIS UNIV. AT URBANA-CHAMPAIGN. DEPT. OF ECOLOGY, ETHOLOGY AND EVOLUTION.
Spatial and Temporal Variability of the Index of Biotic Integrity in Three Midwestern Streams, W89-00026 2E

Effects of Season and Substrate on Availability of Drift for Fish in a Small Warmwater Stream, W89-00400 2H

ILLINOIS UNIV. AT URBANA-CHAMPAIGN. DEPT. OF VETERINARY BIOSCIENCES.
New Measure of Interdependence Among Several Pollutants, W89-01131 5D

ILLINOIS UNIV., URBANA. DEPT. OF CIVIL ENGINEERING.
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Linear Root Water Uptake Model, W89-00353 2I

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Determination of Substituted Aromatic Amines in Water and Sediment Samples, W89-00738 5A

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Generalized Method of Moments Applied to LP3 Distribution, W89-00901 2E

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Summer Dynamics of the Deep Chlorophyll Maximum in Lake Tahoe,
W89-00224 2H

Bacterial Response to Seasonal Changes in Primary Production and Phytoplankton Biomass in Lake Constance,
W89-00225 2H

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Large-Scale and Long-Term Variations in the Zooplankton Community of the Gullmar Fjord, Sweden, in Relation to Advective Processes,
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Cogeneration Power Desalination Plants,
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W89-00886 5D

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Effects of Three Organics on Selected Physical Properties of Type I Portland Cement,
W89-00994 5E

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Chromium Removal from Water by Three Species of Duckweeds,
W89-00109 5D

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Biochemical Composition of the Blue Crab Callinectes sapidus Exposed to the Water-Soluble Fraction of Crude Oil,
W89-00391 5C

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Transmission Electron Microscopic Study of Solidified/Stabilized Organics,
W89-01000 5E

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W89-00883 6E

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Seasonal Changes of Phytoplankton in the Backwater Bokros,
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Microbial Degradation of Xenobiotic, Aromatic Pollutants in Humic Water,
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W89-00739 5F

MARIE CURIE-SKLODOWSKA UNIV., LUBLIN (POLAND).
Chemistry and Delta 13C of Total Dissolved Carbon in Waters of Selected Springs Nearby Lublin City: Weekly Observations from October 1982 to June 1983,
W89-00895 2F

MARINE LAB., ABERDEEN (SCOTLAND).
Hydrography and Plankton of the Moray Firth,
W89-00778 2L

Exploited Fish and Shellfish Species in the Moray Firth,
W89-00779 2L

Monitoring the Moray Firth Environment,
W89-00787 5C

Marine Pollution in Orkney,
W89-00796 5G

Sea and Fresh Waters,
W89-00797 2L

Zooplankton Investigations in the Firth of Clyde,
W89-00814 2L

Benthic Fauna of Sandy Bays, with Particular Reference to Irvine Bay,
W89-00819 5C

Biology and Management of Herring and Other Pelagic Fish Stocks in the Firth of Clyde,
W89-00825 2L

MARINE RESEARCH INST., REYKJAVIK (ICELAND).
Population Dynamics and Production of Chironomidae (Diptera) at 2 m depth in Lake Esrom, Denmark,
W89-00182 2H

MARQUETTE UNIV., MILWAUKEE, WI. DEPT. OF CIVIL ENGINEERING.
Diffuse (Nonpoint) Pollution - A Political, Institutional, and Fiscal Problem,
W89-01134 5G

MARYLAND UNIV., CAMBRIDGE. HORN POINT ENVIRONMENTAL LABS.
Nitrate and Ammonium Uptake by Plankton in an Amazon River Floodplain Lake,
W89-00229 2H

Regeneration and Uptake of Ammonium by Plankton in an Amazon Floodplain Lake,
W89-00230 2H

River-Forced Estuarine Plumes,
W89-00414 2L

MARYLAND UNIV., COLLEGE PARK. DEPT. OF CIVIL ENGINEERING.
Multicriterion Stormwater Management Methods,
W89-00302 4A

MARYLAND UNIV., COLLEGE PARK. DEPT. OF GEOGRAPHY.
Hurricane-Related Morphodynamics and Implications for Hazard Mitigation, Perdido Key, Florida, U.S.A.,
W89-00291 6B

MARYLAND UNIV., SOLOMONS. CENTER FOR ENVIRONMENTAL AND ESTUARINE STUDIES.
Effects of Cadmium on Early Developmental Stages of the Sheepshead Minnow (Cyprinodon Variegatus),
W89-01091 5C

MARYLAND UNIV., SOLOMONS. CHESAPEAKE BIOLOGICAL LAB.
Effects of Co-Occurring Aromatic Hydrocarbons on Degradation of Individual Polycyclic Aromatic Hydrocarbons in Marine Sediment Slurries,
W89-00339 5B

MASSACHUSETTS INST. OF TECH., CAMBRIDGE. DEPT. OF CIVIL ENGINEERING.
Multidimensional Modeling of Cumulative Rainfall: Parameter Estimation and Model Adequacy through a Continuum of Scales,
W89-00706 2B

Fractal Nature of River Networks,
W89-00975 2E

MASSACHUSETTS INST. OF TECH., CAMBRIDGE. DEPT. OF EARTH, ATMOSPHERIC AND PLANETARY SCIENCES.
Methods for Estimating the Critical Shear Stress of Individual Fractions in Mixed-Size Sediment,
W89-00720 2J

Experimental Study of Incipient Motion in Mixed-Sized Sediment,
W89-00721 2J

Variability of Dissolved Trace Metals in the Mississippi River,
W89-01075 5B

MASSACHUSETTS INST. OF TECH., CAMBRIDGE. RALPH M. PARSONS LAB.
Distributed Parameter Approach for Evaluating the Accuracy of Groundwater Model Predictions: 1. Theory,
W89-00711 2F

Distributed Parameter Approach for Evaluating the Accuracy of Groundwater Model Predictions: 2. Application to Groundwater Flow,
W89-00712 2F

Evaluation of a Homogeneous Point Process Description of Arizona Thunderstorm Rainfall,
W89-00724 2B

MASSACHUSETTS UNIV., AMHERST. DEPT. OF FORESTRY AND WILDLIFE MANAGEMENT.
Streamflow Regulation and Fish Community Structure,
W89-01053 4A

MASSACHUSETTS UNIV., AMHERST. DEPT. OF LANDSCAPE ARCHITECTURE.
Recreation Resource Allocation Model for Public Drinking Reservoirs,
W89-00921 6D

MASSACHUSETTS UNIV. AT BOSTON. ENVIRONMENTAL SCIENCE PROGRAM.
Biogeochemistry of Benz(a)anthracene at the Sediment-Water Interface,
W89-00612 5B

MAX-PLANCK-INST. FUER LIMNOLOGIE ZU PLOEN (GERMANY, F.R.). DEPT. OF ECOPHYSIOLOGY.
Discrimination between Algae and Artificial Particles by Freshwater and Marine Copepods,
W89-01047 2H

MCADAMS, ROUX AND ASSOCIATES, DENVER, CO.
Stokes Surfaces and the Effects of Near-Surface Groundwater-Table on Aeolian Deposition,
W89-00410 2J

MCCREARY (SCOTT), CAMBRIDGE, MA.
Prospects for Transfer of the California Coastal Conservancy Model for Habitat Restoration to Other Coastal States,
W89-01070 6E

MCGILL UNIV., MONTREAL (QUEBEC). DEPT. OF BIOLOGY.
Influence of Sediment Composition and Irradiance on the Growth and Morphology of Myriophyllum spicatum L.,
W89-00098 2H

Body Size and Mass Flow in Freshwater Plankton: Models and Tests,
W89-00218 2H

MCGILL UNIV., MONTREAL (QUEBEC). DEPT. OF CIVIL ENGINEERING.
Approximate Confidence Intervals for Verification Criteria of the WMO Intercomparison of Snowmelt Runoff Models,
W89-01143 2E

MCMASTER UNIV., HAMILTON (ONTARIO). DEPT. OF CHEMICAL ENGINEERING.
Biochemical Models for the Hypolimnetic Oxygen Depletion in Lakes Impacted by Wastewater Discharges: 1. Alternative models,
W89-00186 5C

Biochemical Models for the Hypolimnetic Oxygen Depletion in Lakes Impacted by Wastewater Discharges: 2. Phytoplankton Biomass Model,
W89-00189 5C

MCMASTER UNIV., HAMILTON (ONTARIO). DEPT. OF CIVIL ENGINEERING AND ENGINEERING MECHANICS.
Performance of Buried Small Pipes,
W89-00754 8A

MCMASTER UNIV., HAMILTON (ONTARIO). DEPT. OF GEOGRAPHY.
Pipe Flow in James Bay Coastal Wetlands,
W89-00047 2A

MCMASTER UNIV., HAMILTON (ONTARIO). DEPT. OF GEOLOGY.
Surface Reactions of Synthetic, End-member Analogues of Monazite, Xenotime and Rhabdophane, and Evolution of Natural Waters,
W89-01080 2K

MELBOURNE UNIV., PARKVILLE (AUSTRALIA). DEPT. OF MATHEMATICS.
Contaminant Transport in Fractured Porous Media: Steady State Solutions by a Boundary Integral Method,
W89-00982 5B

MELBOURNE UNIV., PARKVILLE (AUSTRALIA). FORESTRY SECTION.
Use of Map Analysis to Elucidate Flooding in an Australian Riparian River Red Gum Forest,
W89-00722 2E

METROPOLITAN WASTE CONTROL COMMISSION, ST. PAUL, MN.
Funding Reserve Capacity in Wastewater Systems,
W89-00506 5D

MICHIGAN STATE UNIV., EAST LANSING. DEPT. OF FISHERIES AND WILDLIFE.
Photo-induced Toxicity of Polycyclic Aromatic Hydrocarbons to Larvae of the Fathead Minnow (Pimephales promelas),
W89-00595 5C

MICHIGAN STATE UNIV., EAST LANSING. PESTICIDE RESEARCH CENTER.
Comparison of Three Sediment Bioassay Methods Using Detroit River Sediments,
W89-01097 5A

MICHIGAN UNIV., ANN ARBOR. DEPT. OF ENVIRONMENTAL AND WATER RESOURCES ENGINEERING.
Estimating Soil/Sediment Partition Coefficients for Organic Compounds by High Performance Reverse Phase Liquid Chromatography,
W89-01223 5B

MIDDLE EAST TECHNICAL UNIV., ANKARA (TURKEY). COASTAL AND HARBOR ENGINEERING CENTER.
Flow Regimes and Dynamic Equilibrium of Morphological Changes at Koycegiz Lake Inlet, Turkey,
W89-00449 8B

MIDDLE EAST TECHNICAL UNIV., ANKARA (TURKEY). INST. OF MARINE SCIENCES.
Long Term Impact of Dissolved Dispersed Petroleum Hydrocarbons (DDPH) in Gulf of Iskenderun,
W89-00567 5B

Two Toxicants, Mercury and Tin in the Gulf of Iskenderun,
W89-00570 5B

MILLER (WADE) ASSOCIATES, INC., ARLINGTON, VA.
Role of the States in Solving the Small System Dilemma,
W89-01111 6E

MINISTERIUM FUER WIRTSCHAFT, MITTELSTAND UND VERKEHR DES LANDES NORDRHEIN-WESTFALEN, DUESSELDORF (GERMANY, F.R.).
Phytoplankton Studies of Slowly Running Waters: Rivers Danube and Vils (Phytoplanktonstudien an langamfliessenden Gewassern: Donau und Vils),
W89-00172 2E

MINISTRY OF AGRICULTURE, JERUSALEM (ISRAEL). HYDROLOGICAL SERVICE.
Enhancement of Runoff From a Small Watershed by Cloud Seeding,
W89-01212 3B

MINISTRY OF WATER CONSERVANCY AND POWER, BEIJING (CHINA). WATER RESOURCES AND HYDROPOWER PLANNING AND DESIGN INST.
China's Experience with Underground Works,
W89-01007 8H

MINISTRY OF WATER RESOURCES AND ELECTRIC POWER, BEIJING (CHINA).
Intensive Hydro Development of the Hongshui River,
W89-01002 8C

MINISTRY OF WORKS AND DEVELOPMENT, HAMILTON (NEW ZEALAND). WATER QUALITY CENTRE.
Benthic Chamber for Use in Rivers: Testing against Oxygen Mass Balances,
W89-00488 7B

MINNESOTA UNIV., MINNEAPOLIS. DEPT. OF CIVIL AND MINERAL ENGINEERING.
Alkalinity Regulation in Softwater Florida Lakes,
W89-00714 2H

New Approximate Technique for the Hodograph Method in Groundwater Flow and Its Application to Coastal Aquifers,
W89-01243 2F

MINNESOTA UNIV., MINNEAPOLIS. LIMNOLOGICAL RESEARCH CENTER.
Development of Streamlined Bog Islands in the Continental Interior of North America,
W89-00434 2H

MINNESOTA UNIV., MINNEAPOLIS. ST. ANTHONY FALLS HYDRAULIC LAB.
Analysis of Turbulent Buoyant Jet in Density-Stratified Water,
W89-00491 5B

Mixing of Temperature-Stratified Lakes and Reservoirs by Buoyant Jets,
W89-00492 5G

MINNESOTA UNIV., ST. PAUL. COLL. OF FORESTRY.
Networking Urban Water Supplies in West Africa,
W89-00419 5F

MINNESOTA UNIV., ST. PAUL. COLL. OF VETERINARY MEDICINE.
Microbial Pollution of Well Water in Southeastern Minnesota,
W89-00887 5B

MINNESOTA VALLEY NATIONAL WILDLIFE REFUGE, BLOOMINGTON, MN.
Identifying Critical Issues in Recreation Planning and Management: Improving the Management-Research Partnership,
W89-00873 6A

MISSISSIPPI STATE UNIV., MISSISSIPPI STATE. DEPT. OF BIOLOGICAL SCIENCES.
Water Column Productivity Attributable to Displaced Benthic Diatoms in Well-Mixed Shallow Estuaries,
W89-00297 2L

MISSOURI UNIV.-ROLLA. DEPT. OF GEOLOGICAL ENGINEERING.
General Correction for Spontaneous Potential Well Logs in Fresh Water,
W89-01195 7B

MITSUBISHI-KASEI INST. OF TOXICOLOGICAL AND ENVIRONMENTAL SCIENCES, YOKOHAMA (JAPAN).
Evaluation of Aquatic Environmental Fate of 2,4,6-Trichlorophenol with a Mathematical Model,
W89-00616 5B

MONASH UNIV., CLAYTON (AUSTRALIA). FACULTY OF ENGINEERING.
Apparatus for Assessing Sulfide Generation Rates from Sewer Slimes,
W89-00497 5D

MONTANA STATE UNIV., BOZEMAN. DEPT. OF MICROBIOLOGY.
Photoexcretion and Fate of Glycolate in a Hot Spring Cyanobacterial Mat,
W89-00342 2H

MONTREAL UNIV. (QUEBEC). DEPT. OF BIOLOGICAL SCIENCES.
Spatial Patchiness in the Lacustrine Sedimentary Environment,
W89-01048 2H

Size Structure of Planktonic Crustaceans in a Dimictic Lake on the Canadian Shield (Structure en Taille des Crustaces Planctoniques d'un Lac Dimictique du Bouclier Canadien),
W89-01231 2H

MORATUWA UNIV. (SRI LANKA). DEPT. OF CIVIL ENGINEERING.
Water Management for Lowland Rice Irrigation,
W89-00750 3F

MORSKI INST. RYBACKI, GDYNIA (POLAND).
Contemporary Changes in Coastal Biocenoses of the Gdansk Bay (South Baltic), A Review,
W89-00254 2L

MUNICIPAL WATERS OF ALICANTE (SPAIN).
Epidemiological Study of the Legionella pneumophila Presence in Potable Water in Alicante,
W89-00925 5A

MUSEO CANTONALE DI STORIA NATURALE, LUGANO (SWITZERLAND).
Drift of Zooplankton in a Lake-Outlet (Glatt) in a Day-Night-Rhythm Depending from the Water Level,
W89-00025 2H

MWANZA FISHERIES RESEARCH CENTRE (TANZANIA).
Effects of a Cyperus papyrus L. Swamp on Domestic Waste Water,
W89-00107 5D

NAGOYA INST. OF TECH. (JAPAN). FACULTY OF TECHNOLOGY.
River Improvement Planning for Flood Protection in the Kiso River Basin until the Meiji Era, (in Japanese),
W89-00204 4A

NAGOYA UNIV. (JAPAN). WATER RESEARCH INST.
Relationship Between delta-D and delta-18-O Values of Falling Snow Particles from a Separate Cloud,
W89-00406 2C

NAGOYA WOMEN'S UNIV. (JAPAN). FACULTY OF HOME ECONOMICS.
Seasonal Change of Iron and Manganese in Lake Fukami-ike: Occurrence of Turbid Manganese Layer,
W89-00770 2H

Dissolved Organic Carbon and Manganese in the Boundary of the Oxic and Anoxic Layers in Lakes Fukami-ike and Suigetsu-ko,
W89-00771 2H

NANCY-1 UNIV. (FRANCE). FACULTE DE PHARMACIE.
Viability Determination of Ascaris Eggs Recovered from Waste-Water,
W89-00644 5A

NANCY-1 UNIV. (FRANCE). SERVICE D'HYDROLOGIE ET DE CLIMATOLOGIE THERAPEUTIQUES.
Comparison of Bacterial Indicators and Sampling Programs for Drinking Water Systems,
W89-00733 5A

NANJING HYDROLOGICAL RESEARCH INST. (CHINA).
Application of Probability Weighted Moments in Estimating the Parameters of the Pearson Type Three Distribution,
W89-01198 7C

NATAL UNIV., DURBAN (SOUTH AFRICA). DEPT. OF CIVIL ENGINEERING.
Programming Model for the Optimal Planning of Water Supply Systems,
W89-00452 6A

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, GREENBELT, MD. HYDROLOGICAL SCIENCES BRANCH.
Macrohydrology: The New Challenge for Process Hydrology,
W89-01012 2A

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, GREENBELT, MD. LAB. FOR ATMOSPHERIC SCIENCES.
Comparison of High-Altitude Remote Aircraft Measurements with the Radar Structure of an Oklahoma Thunderstorm: Implications for Precipitation Estimation from Space,
W89-00844 7B

NATIONAL BOARD OF WATERS, HELSINKI (FINLAND). WATER RESEARCH INST.
Modelling the Effects of Acid Deposition: Estimation of Long-Term Water Quality Responses in Forested Catchments in Finland,
W89-00894 5B

NATIONAL BUREAU OF OCEANOGRAPHY, HANGZHAU (CHINA). SECOND INST. OF OCEANOGRAPHY.
Preliminary Plan for Membrane Desalination in China,
W89-01066 3A

NATIONAL BUREAU OF STANDARDS (NML), GAITHERSBURG, MD. CENTER FOR ANALYTICAL CHEMISTRY.
Determination of Hydrophilic Thiols in Sediment Porewater Using Ion-Pair Liquid Chromatography Coupled to Electrochemical Detection,
W89-00266 7B

NATIONAL CENTER FOR ATMOSPHERIC RESEARCH, BOULDER, CO.
Charge Induced on a Conducting Cylinder by a Point Charge and Its Application to the Measurement of Charge on Precipitation,
W89-00762 7B

NATIONAL COUNCIL OF THE PAPER INDUSTRY FOR AIR AND STREAM IMPROVEMENT, INC., NEW YORK.
Environmental Effects of Paper Industry Wastewaters: An Overview,
W89-00362 5C

NATIONAL FISHERIES CONTAMINANT RESEARCH CENTER, COLUMBUS, OH. FIELD RESEARCH STATION.
Tumor Frequencies and Contaminant Concentrations in Brown Bullheads from an Industrialized River and a Recreational Lake,
W89-00028 5C

NATIONAL GEOPHYSICAL RESEARCH INST., HYDERABAD (INDIA).
Validity of the Environmental Chloride Method for Recharge Evaluation of Coastal Aquifers, India.
W89-00356 7B

NATIONAL HYDROLOGY RESEARCH INST., SASKATOON (SASKATCHEWAN).
Evaporation from Mackenzie Delta Lakes, N.W.T., Canada,
W89-00438 2D

Hydrological Perspective,
W89-01011 2A

NATIONAL HYDROLOGY RESEARCH INST., SASKATOON (SASKATCHWAN). GROUND WATER DIV.
Acidification of Shallow Groundwaters During the Spring Melt Period,
W89-00893 5B

NATIONAL INST. FOR ENVIRONMENTAL STUDIES, TSUKUBA (JAPAN). ENVIRONMENTAL BIOLOGY DIV.
Sedimentation of Phytoplankton Populations Dominated by Microcystis in a Shallow Lake,
W89-00233 2H

NATIONAL INST. FOR WATER RESEARCH, CONGELLA (SOUTH AFRICA). NATAL REGIONAL LAB.
Simple and Efficient New Design of the Submersible Stirrer for the YSI Dissolved Oxygen Meter,
W89-00936 7B

Sedimentary Environments and Facies of the Subtropical Mgeni Estuary, Southeast Africa,
W89-01084 2L

NATIONAL INST. FOR WATER RESEARCH, PRETORIA (SOUTH AFRICA).
Zooplankton Community Grazing in a Hypertrophic Lake (Hartbeespoort Dam, South Africa),
W89-00220 2H

NATIONAL KAOHSIUNG INST. OF TECH. (TAIWAN).
Contamination of Surface Sediments of the Principal Rivers of Geneva Canton by Polychlorinated Biphenyls and DDT (Contamination des Sediments Superficiels des Principales Rivieres du Canton de Geneve par les Polychlorobiphenyles et DDT),
W89-00690 5B

NATIONAL MARINE FISHERIES SERVICE, OXFORD, MD. OXFORD LAB.
Corneal Damage in Larvae of Striped Bass Morone saxatilis Exposed to Copper,
W89-00380 5C

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, ANN ARBOR, MI. GREAT LAKES ENVIRONMENTAL RESEARCH LAB.
Intercomparison of Four Mixed Layer Models in a Shallow Inland Sea,
W89-00831 2H

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, STONY BROOK, NY. OFFICE OF SEA GRANT.
Meteorologically Induced Flushing in Three U.S. East Coast Estuaries,
W89-00281 2L

NATIONAL PUBLIC HEALTH INST., KUOPIO (FINLAND). KUOPIO REGIONAL INST.
Effect of Permanganate Oxidation and Chlorination on the Mutagenic Activity and other Quality Parameters of Artificially Recharged Ground Water Processed from Humus-rich Surface Water,
W89-00599 5F

NATIONAL RESEARCH CENTRE, CAIRO (EGYPT).
Studies on the Degradation of Synthetic Detergents by Sewage,
W89-01159 5B

NATIONAL RESEARCH CENTRE, CAIRO (EGYPT). MICROANALYTICAL RESEARCH LAB.
Determination of Traces of Bismuth in Water with Polyurethane Foam Thin-Layer Spectrophotometry,
W89-00482 5A

NATIONAL RESEARCH CENTRE, CAIRO (EGYPT). WATER POLLUTION CONTROL LAB.
Incidence of Coliphage in Potable Water Supplies,
W89-00338 5F

Treatability Studies of Textile Wastewater,
W89-00627 5D

NATIONAL RESEARCH COUNCIL OF CANADA, OTTAWA (ONTARIO). DIV. OF BIOLOGICAL SCIENCES.
Anaerobic Treatment of Leachate Using Fixed Film and Sludge Bed Systems,
W89-01238 5D

NATIONAL RESEARCH INST. FOR OCEANOLOGY, STELLENBOSCH (SOUTH AFRICA).
Hydrology of the Bot River Estuary,
W89-00654 2L

NATIONAL RESEARCH INST. FOR OCEANOLOGY, STELLENBOSCH (SOUTH AFRICA). MARINE GEOSCIENCE DIV.
Fluvial Sedimentation in the Ebb-Dominated Orange Estuary,
W89-00456 2J

NATIONAL SWEDISH ENVIRONMENT PROTECTION BOARD, NYKOEPING. BRACKISH WATER TOXICOLOGY LAB.
Physiological Disturbances in Fish Exposed to Bleached Kraft Mill Effluents,
W89-00363 5C

Effects of Pulp Mill Effluents on Skeletal Parameters in Fish: A Progress Report,
W89-00365 5C

NATIONAL SWEDISH ENVIRONMENT PROTECTION BOARD, OREGRUND. COASTAL WATER SECTION.
Effects of Pulp Mill Effluent on a Baltic Coastal Fish Community,
W89-00366 5C

Effects of a Bleached Pulp Mill Effluent on Growth and Gonad Function in Baltic Coastal Fish,
W89-00367 5C

NATIONAL SWEDISH ENVIRONMENT PROTECTION BOARD, SOLNA.
Model Ecosystems as a Tool in Freshwater and Marine Research,
W89-00180 5B

NATIONAL SWEDISH ENVIRONMENTAL PROTECTION BOARD, UPPSALA (SWEDEN). ENVIRONMENTAL QUALITY LAB.
Phytoplankton and Reversed Eutrophication in Lake Malaren, Central Sweden, 1965-1983,
W89-01188 5G

NATIONAL TAIWAN UNIV., TAIPEI. INST. OF ENVIRONMENTAL ENGIEERING.
Numerical Modeling of Sorption Kinetics of Organic Compounds to Soil and Sediment Particles,
W89-00981 5B

NATIONAL TECHNICAL UNIV., ATHENS (GREECE). DIV. OF WATER RESOURCES.
Assessment of the Toxicity of Heavy Metals to the Anaerobic Digestion of Sewage Sludge,
W89-00631 5D

NATIONAL TSING HUA UNIV., HSINCHU (TAIWAN). DEPT. OF CHEMISTRY.
Simultaneous Removal of Heavy Metal Ions from Wastewater by Foam Separation Techniques,
W89-00265 5D

NATIONAL WATER RESEARCH INST., BURLINGTON (ONTARIO).
Scientific Concepts and Methodologies Pertinent to Lake Research and Lake Restoration,
W89-00013 2H

Parametric and Nonparametric Tests for Dependent Data,
W89-00864 7C

Is Water a Relevant Sampling Medium for Toxic Chemicals: An Alternative Environmental Sensing Strategy,
W89-01162 5A

NATIONAL WATER RESEARCH INST., BURLINGTON (ONTARIO). AQUATIC ECOLOGY DIV.
Use of Mires in Monitoring the Atmospheric Deposition of Heavy Metals,
W89-00123 5A

NATIONAL WATER RESEARCH INST., BURLINGTON (ONTARIO). RIVERS RESEARCH BRANCH.
Particulate Concentrations in Lake St. Clair as Recorded by a Shipborne Multispectral Optical Monitoring System,
W89-00066 7B

NATIONAL WILDLIFE RESEARCH CENTRE, OTTAWA (ONTARIO).
Organochlorines and Eggshell Thinning in Northern Gannets (Sula bassanus) from Eastern Canada, 1968-1984,
W89-01054 5C

NATURE CONSERVANCY COUNCIL, EDINBURGH (SCOTLAND).
Nature Conservation in the Moray Firth,
W89-00776 2L

Oil Pollution in the Cromarty Firth and Inshore Moray Firth,
W89-00785 5B

Conservation of Natural Resources,
W89-00827 6E

NATURE CONSERVANCY COUNCIL, PETERBOROUGH (ENGLAND).
Saltmarshes of the Firth of Clyde,
W89-00830 2L

Impact of River Regulations on Invertebrate Communities in the U.K.,
W89-00959 4A

River Regulation and Nature Conservation,
W89-00961 4A

NAVAL FACILITIES ENGINEERING COMMAND, PEARL HARBOR, HI. PACIFIC DIV.
Development and Management of Groundwater Resources on Diego Garcia,
W89-00423 4B

NEBRASKA UNIV.-LINCOLN. DEPT. OF AGRICULTURAL ECONOMICS.
New Directions in Nebraska Water Policy,
W89-01266 6E

NEBRASKA UNIV.-LINCOLN. DEPT. OF CIVIL ENGINEERING.
Systems Approach to Nitrate Removal from Groundwater Supplies,
W89-00134 5F

Land Application of Domestic Wastewater, Wood Production, and Sludge Composting: An Economic and Energy Production Analysis,
W89-00465 5E

Nitrate Removal from Water Supplies Using Biological Denitrification,
W89-01237 5F

NEDERLANDS INST. VOOR ONDERZOEK DER ZEE, TEXEL.
Availability of Phosphorus Sources for Blooms of Phaeocystis pouchetii (Haptophyceae) in the North Sea: Impact of the River Rhine,
W89-00004 2L

River Ems: Processes Affecting the Behaviour of Metals and Organochlorines during Estuarine Mixing,
W89-00149 5B

Dredging Activities in the Dutch Wadden Sea: Effects on Macrobenthic Infauna,
W89-00151 2L

Modelling Research on the Production Cycle of Phytoplankton in the Southern Bight of the North Sea in Relation to Riverborne Nutrient Loads,
W89-00157 2L

Flocculation and De-Flocculation of Suspended Matter in Estuaries,
W89-00671 2L

Dynamics of Dissolved Silicium and Nitrogen-Nutrients at Low Temperature in the EMS-Dollard Estuary,
W89-00673 2L

Increased Phytoplankton Primary Production in the Marsdiep Area (Western Dutch Wadden Sea),
W89-00674 5C

Effects on the Benthic Fauna of Embanking an Intertidal Flat Area (The Markiezaat, Eastern Scheldt Estuary, The Netherlands),
W89-00676 6G

NEVADA UNIV., LAS VEGAS. DEPT. OF BIOLOGICAL SCIENCES.
Endangered Woundfin and Water Management in the Virgin River, Utah, Arizona, Nevada,
W89-00311 6G

NEVADA UNIV. SYSTEM, LAS VEGAS. WATER RESOURCES CENTER.
Storm Response of the Karstic Carbonate Aquifer of Southcentral Kentucky,
W89-00349 2A

NEW BRUNSWICK UNIV., FREDERICTON. FIRE SCIENCE CENTRE.
Experimental Studies on the Resiliency of Floating Typha Mats in a Freshwater Marsh,
W89-00287 2H

NEW HAMPSHIRE UNIV., DURHAM. INST. FOR THE STUDY OF EARTH, OCEANS AND SPACE.
Trace Metal Geochemistry of Pore Water Brines from Two Hypersaline Lakes,
W89-01079 2K

NEW HAMPSHIRE UNIV., DURHAM. JACKSON ESTUARINE LAB.
Effects of Sediment Nutrients on Seagrasses: Literature Review and Mesocosm Experiment,
W89-00523 2L

NEW MEXICO INST. OF MINING AND TECHNOLOGY, SOCORRO. DEPT. OF GEOSCIENCE.
Analytical Solution for Aquifer Decontamination by Pumping,
W89-00977 5G

NEW MEXICO INST. OF MINING AND TECHNOLOGY, SOCORRO. DEPT. OF MINING, ENVIRONMENTAL AND GEOLOGICAL ENGINEERING.
Modified Fickian Model for Solute Uptake by Runoff,
W89-00486 5B

NEW MEXICO STATE UNIV., LAS CRUCES. DEPT. OF CIVIL ENGINEERING.
Evaluation of Chemical Oxidizers for Hydrogen Sulfide Control,
W89-01129 5D

NEW MEXICO UNIV., ALBUQUERQUE. DEPT. OF ECONOMICS.
Management of a Tributary Aquifer,
W89-00978 4B

NEW ORLEANS UNIV., LA. CENTER FOR BIO-ORGANIC STUDIES.
Contributions of Heavy Metals from Municipal Runoff to the Sediments of Lake Pontchartrain, Louisiana,
W89-00618 5B

NEW SOUTH WALES INST. OF TECH., BROADWAY (AUSTRALIA). SCHOOL OF LIFE SCIENCES.
Nitrogen Pools and Soil Characteristics of a Temperate Estuarine Wetland in Eastern Australia,
W89-00110 5B

NEW SOUTH WALES UNIV., KENSINGTON (AUSTRALIA). SCHOOL OF CIVIL ENGINEERING.
Problems of Rainfall-Runoff Modelling in Arid and Semiarid Regions,
W89-01144 2E

NEW YORK STATE DEPT. OF ENVIRONMENTAL CONSERVATION, GLOVERSVILLE. HALE CREEK FIELD STATION.
Organochlorine and Mercury Residues in Wild Mink and Otter: Comparison with Fish,
W89-01093 5B

NEW YORK STATE DEPT. OF HEALTH, ALBANY. WADSWORTH CENTER FOR LABS. AND RESEARCH.
Sedimentation of 74 PCB Congeners in the Upper Hudson River,
W89-00584 5B

NEWCASTLE UNIV. (AUSTRALIA). DEPT. OF CHEMISTRY.
Sediment Analysis: Lability of Selectively Extracted Fractions,
W89-00744 5A

NEWCASTLE UNIV. (AUSTRALIA). DEPT. OF CIVIL ENGINEERING.
General Water Supply System Simulation Model: WASP,
W89-00299 5F

NORSK INST. FOR VANNFORSKNING, OSLO.
Lake Enrichment by Submersed Macrophytes: A Norwegian Whole-Lake Experience with Elodea canadensis,
W89-00131 2H

NORTH CAROLINA UNIV. AT WILMINGTON. DEPT. OF BIOLOGICAL SCIENCES.
Tropical Wetlands as a Carbon Source,
W89-00118 2H

NORTH CAROLINA UNIV., CHAPEL HILL. DEPT. OF ENVIRONMENTAL SCIENCES AND ENGINEERING.
Copper Binding by Dissolved Organic Matter: I. Suwannee River Fulvic Acid Equilibria,
W89-01077 5B

Copper Binding by Dissolved Organic Matter: II. Variation in Type and Source of Organic Matter,
W89-01078 5B

Aerobic Biodegradation of Natural and Xenobiotic Organic Compounds By Subsurface Microbial Communities,
W89-01090 5B

NORTH DAKOTA STATE UNIV., FARGO. DEPT. OF CIVIL ENGINEERING.
Maximum Entropy Spectral Analysis of Hydrologic Data,
W89-01248 2A

NORTH DAKOTA STATE WATER COMMISSION, BISMARCK.
In-Situ Method for Monitoring Layered Hydraulic Impedance Development During Artificial Recharge with Turbid Water,
W89-01205 2F

NORTH OF SCOTLAND HYDRO-ELECTRIC BOARD, EDINBURGH.
Future Prospects for Hydro Electricity and Windpower,
W89-00793 6C

Hydropower Development on Rivers in Scotland,
W89-00952 8C

NORTHEASTERN ILLINOIS UNIV., CHICAGO. DEPT. OF BIOLOGY.
Pioneer Colonization and Interaction of Photosynthetic and Heterotrophic Microorganisms on an Artificial Substrate of Polyurethane Foam in E. J. Beck Lake, Illinois,
W89-00398 2H

NORTHERN ARIZONA UNIV., FLAGSTAFF. DEPT. OF POLITICAL SCIENCE.
Interjurisdictional Management in Chesapeake Bay Fisheries,
W89-01073 6E

NORTHROP SERVICES, INC., CORVALLIS, OR.
Longitudinal Changes in Fish Assemblages and Water Quality in the Willamette River, Oregon,
W89-00029 2H

NORTHROP SERVICES, INC., CORVALLIS, OR. ENVIRONMENTAL RESEARCH LAB.
Predicting Regional Episodic Acidification of Surface Waters Using Empirical Models,
W89-00719 5B

NORTHUMBRIAN WATER AUTHORITY, GOSFORTH (ENGLAND).
River Regulation: A Regional Perspective - Northumbrian Water Authority,
W89-00950 4A

NORTHWESTERN UNIV., EVANSTON, IL. DEPT. OF GEOLOGICAL SCIENCES.
Background Aspects of Lake Restoration: Water Balance, Heavy Metal Content, Phosphorus Homeostasis,
W89-00014 2H

NOTRE DAME UNIV., IN. DEPT. OF BIOLOGY.
Effects of Fish Nests on Pattern and Zonation of Submersed Macrophytes in a Softwater Lake,
W89-00092 2H

NOVI SAD UNIV. (YUGOSLAVIA). INST. OF BIOLOGY.
Microbiological Examination of the Carska Bara Swamp Water,
W89-00146 2H

NUVEEN (JOHN) AND CO., INC. CHICAGO, IL.
Financing Strategies for Small Systems,
W89-01113 5F

O'BRIEN AND GERE ENGINEERS, INC., SYRACUSE, NY.
Water Supply Yields Power,
W89-01254 8C

OAK RIDGE NATIONAL LAB., TN. ENVIRONMENTAL SCIENCES DIV.
Potential Importance of Spatial and Temporal Heterogeneity in pH, Al, and Ca in Allowing Survival of a Fish Population: A Model Demonstration,
W89-01052 5C

Effects of Leaching and Whole-Tree Harvesting on Cation Budgets of Several Forests,
W89-01166 4C

OESTERREICHISCHE AKADEMIE DER WISSENSCHAFTEN, VIENNA. BIOLOGISCHE STATION.
Determination of Organic Matter in River Sediments,
W89-00169 7B

Benthic Cyanophyte Associations in Streams and Lakes (Benthische Cyanophyten-Gemeinschaften in Bachen und Seen),
W89-00184 2H

Could Benthic Algae be used as Water Quality Indicators (Konnen Benthische Algen zur Wassergute-Bestimmung Herangezogen Werden),
W89-00194 5A

OFFICE OF SCIENCE AND TECHNOLOGY POLICY, WASHINGTON, DC.
Long-term Study of Ecosystem Contamination with 2,3,7,8-Tetrachlorodibenzo-p-dioxin,
W89-00603 5B

OFFICE OF THE CZECHOSLOVAK FEDERAL PREMIER, PRAGUE.
Utilization of Nitrogenous Nutrients by Natural Phytoplankton in Enriched Lake Waters,
W89-00773 2H

OHIO AGRICULTURAL RESEARCH AND DEVELOPMENT CENTER, WOOSTER. DEPT. OF ENTOMOLOGY.
Effects of Simulated Acidic Precipitation on Plant-Insect Interactions in Agricultural Systems: Corn and Black Cutworm Larvae,
W89-01160 5C

OHIO COOPERATIVE FISHERY RESEARCH UNIT, COLUMBUS.
Eutrophication Effects of Prey Size and Food Available to Yellow Perch in Lake Erie,
W89-00030 5C

OHIO STATE UNIV., COLUMBUS. COLL. OF LAW.
Recurring State Judicial Task of Choosing Rules for Groundwater Law: How Occult Still,
W89-01268 6E

OHIO STATE UNIV., COLUMBUS. DEPT. OF AGRONOMY.
Properties of Water Treatment Lime Sludges and Their Effectiveness as Agricultural Limestone Substitutes,
W89-00516 5F

OHIO STATE UNIV., COLUMBUS. DEPT. OF CIVIL ENGINEERING.
Determinations of Suspended Sediment Concentrations from Multiple Day Landsat and AVHRR Data,
W89-00064 7B

OHIO UNIV., ATHENS. DEPT. OF CIVIL ENGINEERING.
Stochastic Forecast of Water Losses,
W89-00759 7B

OKLAHOMA COOPERATIVE FISHERY RESEARCH UNIT, STILLWATER.
Relations Between Habitat Variables and Channel Catfish Populations in Prairie Streams,
W89-00325 2H

OKLAHOMA UNIV., NORMAN. DEPT. OF ZOOLOGY.
Susceptibility of Young-of-the-Year Fishes to Downstream Displacement by Flooding,
W89-00295 2H

OLDENBURG UNIV. (GERMANY, F.R.). FACHBEREICH 7 - BIOLOGIE.
Examination of the Connection Between the Patchiness of Benthic Nutrient Efflux and Epiphytobenthos Patchiness on Intertidal Flats,
W89-00161 2L

ONTARIO MINISTRY OF NATURAL RESOURCES, THUNDER BAY. FISHERIES RESEARCH SECTION.
Application of Ecological Modelling: Impact of Thermal Effluent on a Smallmouth Bass Population,
W89-00317 5C

ONTARIO MINISTRY OF THE ENVIRONMENT, DORCHESTER. DORSET RESEARCH CENTER.
Richness of Aquatic Macrophyte Floras of Soft Water Lakes of Differing pH and Trace Metal Content in Ontario, Canada,
W89-00103 5C

Effects of Acidification on Metal Budgets of Lakes and Catchments,
W89-00207 5C

Effects of Sulphur Deposition on Lake-Water Chemistry in Ontario, Canada,
W89-00846 5B

Multisignal Automatic Calibration Methodology for Hydrochemical Models: A Case Study of the Birkenes Model,
W89-00973 5B

ONTARIO MINISTRY OF THE ENVIRONMENT, REXDALE.
Testing a Comprehensive Acid Deposition Model,
W89-00310 5B

ONTARIO MINISTRY OF THE ENVIRONMENT, REXDALE. LAB. SERVICES BRANCH.
Emissions of Chlorinated Organics from a Municipal Sewage Sludge Burning Incinerator,
W89-00607 5B

ONTARIO MINISTRY OF THE ENVIRONMENT, TORONTO. AIR RESOURCES BRANCH.
Relative Roles of Emissions Changes and Meteorological Variability of Wet sulfur Deposition: A Trajectory Model Study,
W89-01259 5B

ORANGE FREE STATE UNIV., BLOEMFONTEIN (SOUTH AFRICA).
Determination of Water Use Efficiency of Veld in the Central Orange Free State from Evapotranspiration Measurements (Bepaling van Waterverbruiksdoeltreffendheid van Veld in die Sentrale Oranje-Vrystaat Vanaf Evapotranspirasiemetings),
W89-00934 2D

OREGON COOPERATIVE FISHERY RESEARCH UNIT, CORVALLIS.
Physiological Effects on Coho Salmon and Steelhead of Exposure to Suspended Solids,
W89-00292 5C

OREGON GRADUATE CENTER, BEAVERTON. DEPT. OF ENVIRONMENTAL SCIENCE AND ENGINEERING.
Discrete Point Sampler for Ground Water Monitoring Wells,
W89-00947 7B

OREGON STATE UNIV., CORVALLIS. DEPT. OF AGRICULTURAL ENGINEERING.
Geostatistics Applied to Groundwater Pollution: III. Global Estimates,
W89-00493 5B

OREGON STATE UNIV., CORVALLIS. DEPT. OF BOTANY AND PLANT PATHOLOGY.
Effects of Sediment Properties on Benthic Primary Production in the Columbia River Estuary,
W89-00115 2L

OREGON STATE UNIV., CORVALLIS. OAK CREEK LAB. OF BIOLOGY.
Utility of Laboratory Streams for Ecosystem Toxicity Studies,
W89-01059 5B

OSAKA PREFECTURE INST. OF PUBLIC HEALTH (JAPAN).
Polybrominated Biphenyl Ethers in Marine Fish, Shellfish, and River and Marine Sediments in Japan,
W89-00610 5B

OSLO UNIV. (NORWAY). DEPT. OF BIOLOGY.
Nitrate Reductase Activity in Phytoplankton from the Oslo-fjord, Norway,
W89-00226 2H

OSLO UNIV. (NORWAY). INST. OF MARINE BIOLOGY.
Effects of Disturbance and Severe Seasonal Fluctuations in Environmental Conditions on North Temperate Shallow-water Fish Assemblages,
W89-00282 2L

Population Genetics of Mytilus edulis (L.) from Oslofjorden, Norway in Oil-Polluted and Non Oil-Polluted Water,
W89-01009 5C

OXFORD UNIV. (ENGLAND). GEOGRAPHY SCHOOL.
Stream Nitrate Levels in a Small Catchment in South West England Over a Period of 15 Years (1970 - 1985),
W89-00915 5B

OXFORD UNIV. (ENGLAND). SOIL SCIENCE LAB.
Soil Solution in a Soil Treated with Digested Sewage Sludge,
W89-00413 5B

PACE UNIV., PLEASANTVILLE, NY.
Feeding and Swimming Behavior in Grazing Microzooplankton,
W89-00382 2H

PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION, COLLEGE, AK. INST. OF NORTHERN FORESTRY.
Effects of Stream Cleaning on Juvenile Coho Salmon and Dolly Varden in Southeast Alaska,
W89-00374 2H

PADUA UNIV. (ITALY). DEPT. OF BIOLOGY.
Micronucleus Test: Examples of Application to Marine Ecology,
W89-01042 5A

PAISLEY COLL. OF TECH. (SCOTLAND). DEPT. OF BIOLOGY.
Epilithic Diatoms of the Clyde Estuary,
W89-00808 2L

PALERMO UNIV. (ITALY). DIPT. DI ECONOMIA INGENERIA E TECHNOLOGIE AGRARIE.
Estimation of the Time Scale of the Geomorphologic Instantaneous Unit Hydrograph from Effective Streamflow Velocity,
W89-00704 2E

PARIS-7 UNIV. (FRANCE). LAB. DE CYTOPHYSIOLOGIE VEGETALE ET TOXICOLOGIE CELLULAIRE.
Use of Factorial Experimental Design to Evaluate How Biotic and Abiotic Factors Influence Cadmium Accumulation in the Unicellular Alga Dunaliella bioculata,
W89-01043 5B

PARIS-7 UNIV. (FRANCE). LAB. DE PHYSICO-CHIMIE DE L'ATMOSPHERE.
Rain-Aerosol Coupling in Urban Area: Scavenging Ratio Measurement and Identification of Some Transfer Processes,
W89-00430 2B

PARKMAN CONSULTING ENGINEERS, LIVERPOOL (ENGLAND).
Use of Network Analysis Techniques in the Development and Optimization of a large UK Urban Water Distribution System (L'Emploi de Techniques),
W89-00918 5F

PATRAS UNIV. (GREECE). DEPT. OF CHEMISTRY.
Cotton Yarn and Fabric Finishing Wastewater Treatment in Upflow Anaerobic Filter,
W89-00277 5D

Wet-Only Precipitation Study in a Mediterranean Site, Patras, Greece,
W89-01152 2B

PAUL SCHERER INST., WUERENLINGEN (SWITZERLAND).
Determination of Mono- and Divalent Cations and Anions in Small Fog Samples by Ion Chromatography,
W89-00372 5A

PENNSYLVANIA DEPT. OF ENVIRONMENTAL RESOURCES, NORRISTOWN.
Periphyton, Benthic Invertebrates and Fishes as Biological Indicators of Water Quality in the East Branch Brandywine Creek,
W89-00314 5A

PENNSYLVANIA STATE UNIV. SHENANGO VALLEY CAMPUS, SHARON.
Unionid (Mollusca:Bivalvia) Fauna of the Shenango River in Mercer County, Pennsylvania,
W89-00312 5C

PERTANIAN MALAYSIA UNIV., SERDANG. DEPT. OF CHEMISTRY.
Solubilities of Trace Copper and Lead Species and the Complexing Capacity of River Water in the Linggi River Basin,
W89-00084 5B

PERUGIA UNIV. (ITALY). CATTEDRA DI IGIENE.
Definition of a Model for Monitoring the Chemical and Chemical-Physical Characteristics of Deep Drinking Waters,
W89-00927 7C

POLISH ACADEMY OF SCIENCES, KRAKOW. ZAKLAD BIOLOGII WOD.
Development of Microorganisms on the Background of Organic Matter in Forest Ecosystem Waters,
W89-00080 2H

Chemical Mechanisms of Heavy Metal Transport in Waters of Mala Panew and Brynica Rivers (Silesia, Poland),
W89-00251 5B

Effect of Drainage Basin on Heavy Metal Concentrations in Stream Waters in the Niepolomice Forest,
W89-00260 5B

POLISH ACADEMY OF SCIENCES, KRAKOW. ZAKLAD OCHRONY PRZYRODY I ZASOBOW NATURALNYCH.
Chemistry of Atmospheric Precipitation in the Babia Gora National Park,
W89-00082 5B

POLISH ACADEMY OF SCIENCES, LOMIANKI. INST. EKOLOGII.
Indicatory Role of Some Invertebrates for Quality of Water in the Vistula River and in Subsequent Stages of Its Treatment,
W89-00236 5A

POLISH ACADEMY OF SCIENCES, SOPOT. INST. OF OCEANOLOGY.
Influence of the Vistula River on Distribution of 226Ra in the Gdansk Bay,
W89-00250 2K

POLISH ACADEMY OF SCIENCES, TUREW. DEPT. OF AGROBIOLOGY.
Estimation of Phytoplankton Biomass and Production, and Organic Matter Decomposition in Three Small Field-Ponds,
W89-00252 2H

POLISH ACADEMY OF SCIENCES, WARSAW. INST. OF GEOGRAPHY.
Diurnal Fluctuations of Phosphorus Forms in Lake Water and Seston in Pluss-See,
W89-00246 2H

PORT ELIZABETH UNIV. (SOUTH AFRICA). DEPT. OF BOTANY.
Spatial Patterns of N Fixation (Acetylene Reduction) along Environmental Gradients in a Warm-Temperate Estuary,
W89-00475 2L

PORTAGE COUNTY, WI.
State Program Solves County Salt Storage Problem,
W89-00466 5G

POTCHEFSTROOM UNIV. FOR C.H.E. (SOUTH AFRICA). DEPT. OF ZOOLOGY.
Uptake and Distribution of Copper Sulphate and Its Effect on the Respiration Rate of the Hemocyanin-Producing Freshwater Snail Lymnaea natalensis,
W89-01155 5G

POZNAN TECHNICAL UNIV. (POLAND). INST OF ENVIRONMENTAL ENGINEERING.
Concentrations of Nitrogen and Phosphorus in Waters of Two Hypertrophic Lakes and Their Effect on the Quantity of Phytoplankton Biomass,
W89-00245 2H

PRETORIA UNIV. (SOUTH AFRICA). DEPT. OF CHEMICAL ENGINEERING.
Bulking Control with Ozonation in a Nutrient Removal Activated Sludge System,
W89-00930 5D

PRINCETON UNIV., NJ. DEPT. OF AEROSPACE AND MECHANICAL SCIENCES.
Tropical Eutrophic Lake Modeling and Parameter Discrimination,
W89-00872 2H

PRINCETON UNIV., NJ. DEPT. OF CIVIL ENGINEERING.
Sorption and Desorption Dynamics of Aroclor 1242 to Natural Sediment,
W89-00991 5B

PROCESS APPLICATIONS, INC., FORT COLLINS, CO.
Design Considerations for Package Water Treatment Systems,
W89-01117 5F

PROCTER AND GAMBLE CO., CINCINNATI, OH. ENVIRONMENTAL SAFETY DEPT.
Impact of a Municipal Wastewater Effluent on Water Quality, Periphyton, and Invertebrates in the Little Miami River Near Xenia, Ohio,
W89-00685 5C

Nitrilotriacetic Acid (NTA) Environmental Monitoring Program in Indiana: 1979 to 1983,
W89-01089 5A

PROFESSIONAL SERVICES GROUP, INC., HOUSTON, TX.
Selecting a Contract Operator for Your Water or Wastewater Facility,
W89-01100 5F

PTI ENVIRONMENTAL SERVICES, SEATTLE, WA.
Hepatic Lesions in English Sole (Parophrys vetulus) from Commencement Bay, Washington (USA),
W89-00859 5C

PURDUE UNIV., LAFAYETTE, IN. DEPT. OF EARTH AND ATMOSPHERIC SCIENCES.
Single-Well Tracing Method for Estimating Regional Advective Velocity in a Confined Aquifer: Theory and Preliminary Laboratory Verification,
W89-00707 2F

PURDUE UNIV., LAFAYETTE, IN. SCHOOL OF CIVIL ENGINEERING.
Planning Indiana's Water Infrastructure from a Competitive Perspective,
W89-00880 6B

QIT-FER ET TITANE, INC., MONTREAL (QUEBEC).
Extreme Pressures in Hydraulic-Jump Stilling Basins,
W89-00896 8B

QUEBEC MINISTERE DE L'ENVIRONNEMENT, SAINTE-FOY. DIRECTION DE LA QUALITE DU MILIEU AQUATIQUE.
Nonparametric Tests for Trend Detection in Water Quality Time Series,
W89-00867 7C

QUEBEC UNIV., MONTREAL. ECOLE DE TECHNOLOGIE SUPERIEURE.
Application of Principal Component Analysis to Long-Term Reservoir Management,
W89-00698 6A

QUEBEC UNIV., RIMOUSKI. DEPT. OF OCEANOGRAPHY.
Satellite Observations of Tidal Upwelling and Mixing in the St. Lawrence Estuary,
W89-00834 2L

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Multi-Component Sorption Isotherms of Basic Dyes onto Peat,
W89-00083 5D

RANNSOKNASTOFNUN LANDBUNADARINS, REYKJAVIK (ICELAND).
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W89-00436 4C

REGENSBURG UNIV. (GERMANY, F.R.). INST. FUER ANORGANISCHE CHEMIE.
Isotope Ratio Measurements of Mo, V, Ti, and Zr and the Determination of These Elements in Water Samples with a Thermal Ionization Quadrupole Mass Spectrometer (Isotopenverhaltnismessung von Mo, V, Ti and Zr Sowie Deren Konzentrationsbestimmung in Wassern Mit Einem Thermionen-Quadrupol-Massenspektrometer),
W89-00267 5A

Chromium Trace Determination in Inorganic, Organic and Aqueous Samples with Isotope Dilution Mass Spectrometry (Chromspurenbestimmungen in Anorganischen, Organischen und wa-Brigen Proben mit der Massenspektrometrischen Isotopenverdunnungsanalyse),
W89-00268 5A

Determination of Nitrate at the Ng/g Level in Antarctic Snow Samples with Ion Chromatography and Isotope Dilution Mass Spectrometry,
W89-00269 5A

Determination of Heavy Metals at the Pg/g Level in Antarctic Snow with DPASV and IDMS,
W89-00270 5A

Negative Thermal Ionization Mass Spectrometry of Selenium: Part 1. Isotope Ratio Measurements and Determinations in Aquatic Systems with the Isotope Dilution Technique (Negative Thermionen-Massenspektrometrie von Selen: Teil 1. Isotopenverhaltnismessungen sowie Konzentrationsbestimmungen in Aquatischen Systemen mit der Isotopenverduennungsanalyse),
W89-00737 5A

Nitrate Trace Determinations in Snow and Firn Core Samples of Ice Shelves at the Weddell Sea, Antarctica,
W89-01258 5B

RENSSELAER POLYTECHNIC INST., TROY, NY. DEPT. OF BIOLOGY.
Patterns of Epipelic Algal Distribution in an Acidic Adirondack Lake,
W89-00298 2H

RHODE ISLAND UNIV., KINGSTON. DEPT. OF BOTANY.
Biomass, Productivity and Life History Traits of Juncus militaris Bigel. in Two Rhode Island (U.S.A.) Freshwater Wetlands,
W89-00100 2H

RHODE ISLAND UNIV., KINGSTON. DEPT. OF CIVIL AND ENVIRONMENTAL ENGINEERING.
In situ Adapation of Activated Sludge by Shock Loading to Enhance Treatment of High Ammonia Content Petrochemical Wastewater,
W89-01127 5D

RHODE ISLAND UNIV., KINGSTON. GRADUATE SCHOOL OF OCEANOGRAPHY.
Nitrogen Dynamics in Lower Narragansett Bay: II. Phytoplankton Uptake, Depletion Rates of Nitrogenous Nutrient Pools, and Estimates of Ecosystem Remineralization,
W89-00215 2L

RHODES UNIV., GRAHAMSTOWN (SOUTH AFRICA). DEPT. OF GEOGRAPHY.
Spatial Variability of Short-Term Rainfall Amounts in a Coastal Mountain Region of Southern Africa,
W89-00932 2B

RHODES UNIV., GRAHAMSTOWN (SOUTH AFRICA). DEPT. OF ZOOLOGY AND ENTOMOLOGY.
Flux of Organic Carbon in a Tidal Salt Marsh, Kowie River Estuary, Port Alfred, South Africa,
W89-00453 2L

RIJKSINSTITUUT VOOR NATUURBEHEER, LEERSUM (NETHERLANDS).
Ecohydrological Approach to Floral and Vegetational Patterns in Arctic Landscape Ecology,
W89-00435 2H

RIJKSWATERSTAAT-DELTADIENST, THE HAGUE (NETHERLANDS).
Experimental Determination of Salt Intrusion Mechanisms in the Volkerak Estuary,
W89-00667 2L

RIJKSWATERSTAAT, THE HAGUE (NETHERLANDS). DIV. OF TIDAL WATERS.
Monitoring of Mercury Pollution in Dutch Coastal Waters by Means of the Teleostean Fish Zoarces Viviparus,
W89-00150 5C

Tidal Asymmetry and Estuarine Morphology,
W89-00670 2L

RIVERSIDE TECHNOLOGY, FORT COLLINS, CO.
Flow Capacity of Culverts on Oregon Coast Range Forest Roads,
W89-00878 8B

ROBERT S. KERR ENVIRONMENTAL RESEARCH LAB., ADA, OK.
Sorption Nonequilibrium During Solute Transport,
W89-00988 5B

ROCHESTER UNIV., NY.
Climatography of Thunder Events in the Conterminous United States: Part I: Temporal Aspects,
W89-00274 2B

Climatography of Thunder Events in the Conterminous United States: Part II: Spatial Aspects,
W89-00275 2B

ROORKEE UNIV. (INDIA). DEPT. OF CIVIL ENGINEERING.
Generalized Rectangular Weir Equations,
W89-00905 8B

ROSTOCK UNIV. (GERMAN D.R.). DEPT. OF BIOLOGY.
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W89-00135 5C

ROYAL NETHERLANDS METEOROLOGICAL INST., DE BILT.
Model Output Statistics Forecasts: Three Years of Operational Experience in the Netherlands,
W89-00843 2B

RUHR UNIV., BOCHUM (GERMANY, F.R.). INST. FOR HYDROLOGY, WATER RESOURCES AND ENVIRONMENTAL ENGINEERING.
Remote Sensing in Hydrology,
W89-01019 2A

RURAL COMMUNITY ASSISTANCE CORP., SACRAMENTO, CA.
Rural Community Assistance Program,
W89-01115 5F

RUTGERS - THE STATE UNIV., CAMDEN, NJ. DEPT. OF BIOLOGY.
Stream Chemistry in the New Jersey Pinelands: The Influence of Precipitation and Watershed Disturbance,
W89-00716 5B

RUTGERS - THE STATE UNIV., NEW BRUNSWICK, NJ. DEPT. OF CHEMICAL AND BIOCHEMICAL ENGINEERING.
Design Criteria for In-Situ and On-Site Renovation of an Industrial Sludge Lagoon,
W89-00996 5B

S.S.V.P. SANTHA'S SCIENCE COLL., DHULE (INDIA). P.G. DEPT. OF BOTANY.
Species Diversity of Algal Flora in Vishwamitri River, Baroda (India),
W89-00234 2H

SAINT ANDREWS UNIV. (SCOTLAND). DEPT. OF PLANT BIOLOGY AND ECOLOGY.
Growth Strategies and Distribution of Isoetids in Scottish Freshwater Lochs,
W89-00129 5C

SAINT ANDREWS UNIV. (SCOTLAND). SCHOOL OF MATHEMATICAL SCIENCES.
Location-Invariant Plotting Positions for PWM Estimation of the Parameters of the GEV Distribution,
W89-00351 2E

Assessment of Flood Frequency Models Using Empirical Distribution Function Statistics,
W89-00976 2E

SAN DIEGO STATE UNIV., CA.
Sediment Delivery in a Semi-arid Coastal Stream,
W89-00346 2J

SAN FRANCISCO STATE UNIV., CA.
Mesoscale Spiral Vortex Embedded within a Lake Michigan Snow Squall Band: High Resolution Satellite Observations and Numerical Model Simulations,
W89-00748 2B

SAO PAULO UNIV., RIBEIRAO PRETO (BRAZIL). FACULDADE DE FILOSOFIA, CIENCIAS E LETRAS.
Fish Communities in Reservoirs in Southern Brazil (Comunidades de Peixes de Reservatorios no Sul do Brasil),
W89-00011 2H

SASKATCHEWAN UNIV., SASKATOON. DEPT. OF BIOLOGY.
Effects of Acute Exposure to Acidified Water on the Behavorial Response of Fathead Minnows, Pimephales Promelas, to Alarm Substance (Schreckstoff),
W89-01092 5C

SASKATCHEWAN UNIV., SASKATOON. DEPT. OF CIVIL ENGINEERING.
Outlet Structure Design for Conduits and Tunnels,
W89-00307 8A

Modelling of Flow Through Potash Tailings Piles,
W89-00388 5B

SCIENCE UNIV. OF TOKYO (JAPAN). FACULTY OF PHARMACEUTICAL SCIENCES.
Formation of 1-Nitropyrene by Photolysis of Pyrene in Water Containing Nitrite Ion,
W89-00586 5B

Photochemical Reaction of Biphenyl in Water Containing Nitrite or Nitrate Ion,
W89-00593 5B

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W89-00890 2H

SCOTTISH NATURAL HISTORY MUSEUM, KILBARCHAN.
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W89-00826 5C

SENTER FOR INDUSTRIFORSKNING, OSLO (NORWAY).
Evaluation of the 'Fugacity' (FEQUM) and the 'EXAMS' Chemical Fate and Transport Models: A Case Study on the Pollution of the Norrsundet Bay (Sweden),
W89-00357 5B

Methods for Determination of Sum Parameters and Characterization of Organochlorine Compounds in Spent Bleach Liquors from Pulp Mills and Water, Sediment and Biological Samples from Receiving Waters,
W89-00358 5A

Investigations of Chlorinated Thiophenes: A Group of Bioaccumulable Compounds Identified in the Effluents from Kraft Bleaching,
W89-00360 5B

Assessing the Birkenes Model of Stream Acidification Using a Multisignal Calibration Methodology,
W89-00974 7B

SETSUNAN UNIV., NEYAGAWA (JAPAN). FACULTY OF PHARAMACEUTICAL SCIENCES.
Monitoring of PCDDs in Osaka Bay Using Blue Mussel,
W89-00604 5B

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Water Quality Management: A Regional Perspective-The Severn-Trent Area,
W89-00951 5G

Regulating the River Severn,
W89-00954 4A

Outstanding Problems in River Regulation,
W89-00963 4A

SHELL DEVELOPMENT CO., HOUSTON, TX.
Determination of Naphthenic Acids in California Crudes and Refinery Wastewaters by Fluoride Ion Chemical Ionization Mass Spectrometry,
W89-00209 5A

Degradation of Bisphenol A in Natural Waters,
W89-00600 5B

SHIMANE UNIV., MATSUE (JAPAN). FACULTY OF AGRICULTURE.
Nitrogen Metabolism in the Brackish Lake Nakanoumi. III. Nitrification-Dentrification in Low Concentration of Dissolved Oxygen, (in Japanese),
W89-00769 2H

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Variations in Polychlorinated Biphenyl Congener Composition in Eggs of Mediterranean Water Birds in Relation to their Position in the Food Chain,
W89-01056 5B

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Polychlorinated Biphenyls in the Kupa River, Croatia, Yugoslavia,
W89-00609 5B

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Simple, Reliable, and Inexpensive Pore-Water Sampler,
W89-01051 7B

SLOVENSKA AKADEMIA VIED, BRATISLAVA (CZECHOSLOVAKIA). USTAV EXPERIMENTALENJ BIOLOGIE A EKOLOGIE.
Bacterial Degradation of Crude Oil Water Pollutants in Danube Water (Die bakterielle Degradation von Erdolkohlenwasserstoffen im Donauwasser),
W89-00168 5B

SMITH AND SCHNACKE, CINCINNATI, OH.
Drafting Water Quality Agreements,
W89-01253 6E

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Coastal Management Issues for the Mouth of the River Murray, South Australia,
W89-01072 6E

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Exchange of Phosphorus between a Euhaline Vegetated Marsh and the Adjacent Tidal Creek,
W89-00283 5B

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Relationship between Nitrogen-Fixing Sulfate Reducers and Fermenters in Salt Marsh Sediments and Roots of Spartina alterniflora,
W89-00732 2L

SOUTHAMPTON UNIV. (ENGLAND). DEPT. OF BIOLOGY.
Feeding of a Freshwater Flagellate, Bodo saltans, on Diverse Bacteria,
W89-00381 2H

SOUTHAMPTON UNIV. (ENGLAND). DEPT. OF GEOGRAPHY.
Peatland Soil-Plant Relationships in the New Forest,
W89-00122 2H

SOUTHERN CALIFORNIA COASTAL WATER RESEARCH PROJECT, LONG BEACH.
Contaminant Concentrations and Toxicity of Sea-Surface Microlayer Near Los Angeles, California,
W89-00857 5C

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W89-00399 5C

SOUTHERN ILLINOIS UNIV. AT CARBONDALE. FISHERIES RESEARCH LAB.
Influence of pH and Ammonia Salts on Ammonia Toxicity and Water Balance in Young Channel Catfish,
W89-00377 5C

SOUTHERN ILLINOIS UNIV. AT EDWARDSVILLE. ENVIRONMENTAL RESOURCES TRAINING CENTER.
MCRT for Control of Cokemaking Wastewater treatment,
W89-01139 5D

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Role of Sewage Effluent in the Accumulation of Macroalgal Mats on Intertidal Mudflats in Two Basins in Southern England,
W89-00159 5C

SOUTHERN WATER AUTHORITY, OTTERBOURNE (ENGLAND). HAMPSHIRE DIV.
River Regulation by Seasonal Groundwater Abstraction: The Case of the River Itchen,
W89-00956 4B

SPECIALIST OFFSHORE SURVEYS PTY LTD., NEWLANDS (SOUTH AFRICA).
Barrier/Estuarine Processes. Bot River Estuary: An Interpretation of Aerial Photographs,
W89-00650 2L

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Sorption of Cationic Oligomers on Sediments,
W89-01094 5B

STAATLICHES INST. FUER SEENFORSCHUNG UND FISCHEREIWESEN, LANGENARGEN (GERMANY, F.R.).
Loss Processes Influencing Growth of Planktonic Bacterial Populations in Lake Constance,
W89-00217 2H

STATE UNIV. OF NEW YORK AT ALBANY. ATMOSPHERIC SCIENCES RESEARCH CENTER.
Comparisons of RADM and Oscar Precipitation Chemistry Data,
W89-00433 5B

STATE UNIV. OF NEW YORK AT BUFFALO. DEPT. OF BIOLOGICAL SCIENCES.
Relationship Between Glacial Geology and Streamwater Chemistry in an Area Receiving Acid Deposition,
W89-01210 5B

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PCB-resistant Diatoms in the Hudson River Estuary,
W89-00284 5C

Age to PCB Concentration Relationship with the Striped Bass (Morone saxatilis) in the Hudson River and Long Island Sound,
W89-00597 5B

Induced Resistance to Polychlorinated Biphenyls Confers Cross-Resistance and Altered Environmental Fitness in a Marine Diatom,
W89-00860 5C

STATE UNIV. OF NEW YORK UPSTATE MEDICAL CENTER, SYRACUSE.
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W89-00558 5C

STATION ZOOLOGIQUE, VILLEFRANCHE-SUR-MER (FRANCE).
Pelagic Ecosystem Model Simulating Production and Sedimentation of Biogenic Particles: Role of Salps and Copepods,
W89-01041 2L

STEARNS AND WHEELER, CAZENOVIA, NY.
Simulation of Regional Ground Water Flow in Bedrock, Southwestern New York-Northwestern Pennsylvania,
W89-00882 2F

STELLENBOSCH UNIV. (SOUTH AFRICA). INST. FOR POLYMER SCIENCE.
Formation of Hydrous Zirconium (IV) Oxide Polyelectrolyte Membranes, I. Poly (itaconic acid) and Poly (acrylic-co-itaconic acid),
W89-01062 3A

STEVENS INST. OF TECH., HOBOKEN, NJ. DEPT. OF CIVIL AND OCEAN ENGINEERING.
Ozone-Induced Particle Destabilization,
W89-01120 5F

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Analysis of Halogenated Polycyclic Aromatic Hydrocarbons in Urban Air, Snow and Automobile Exhaust,
W89-00613 5B

STOCKHOLM UNIV. (SWEDEN). DEPT. OF ZOOLOGY.
Response of Benthic Meiofauna to Nutrient Enrichment of Experimental Marine Ecosystems,
W89-01033 5C

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Conjugal Transfer of R68.45 and FP5 between Pseudomonas aeruginosa Strains in a Freshwater Environment,
W89-00728 5B

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Summer of 1987 in North-East England,
W89-00463 2B

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Extreme-Value Theory Model for Dependent Observations,
W89-01208 7C

SVENSKA TRAEFORSKNINGSINSTITUTET, STOCKHOLM.
Fate of Spent Bleach Liquor Material in Receiving Waters: Characterization of Chloroorganics in Sediments,
W89-00371 5B

SVERIGES LANTBRUKSUNIVERSITET, UPPSALA. INST. FOER EKOLOGI OCH MILJOEVAARD.
Changes in Soil Acidity in Two Forest Areas with Different Acid Deposition: 1920s to 1980s,
W89-00444 5B

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Environmental Fate of Chloroguaiacols and Chlorocatechols,
W89-00369 5B

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Comparison of Drinking Water Mutagenicity with Leaching of Polycyclic Aromatic Hydrocarbons from Water Distribution Pipes,
W89-00619 5C

SYRACUSE UNIV., NY. DEPT. OF CIVIL ENGINEERING.
Alternative Strategies for Stormwater Detention,
W89-00875 4A

TATA CONSULTING ENGINEERS, BOMBAY (INDIA).
Planning and Construction of the Pahalgam Scheme,
W89-01004 8A

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Estimation of Catchment Rainfall Uncertainty and its Influence on Runoff Prediction,
W89-00892 2A

TECHNION - ISRAEL INST. OF TECH., HAIFA.
Trihalomethane Formation in High-Bromide Lake Galilee Water,
W89-00426 5F

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Continuum Models for Contaminant Transport in Fractured Porous Formations,
W89-00966 5B

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W89-01185 5D

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W89-00175 5C

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Food Web Manipulation Without Nutrient Control: A Useful Strategy in Lake Restoration,
W89-00019 5G

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W89-00137 2H

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W89-00636 5B

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W89-00501 5B

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W89-00687 2F

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W89-00503 2F

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Vertically Integrated Snow/Ice Model over Land/Sea for Climate Models: 1. Development,
W89-01260 2C

Vertically Integrated Snow/Ice Model over Land/Sea for Climate Models: 2. Impact on Orbital Change Experiments,
W89-01261 2C

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Time-Dependent Macrodispersion for Solute Transport in Anisotropic Heterogeneous Aquifers,
W89-01245 2F

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W89-01235 5D

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W89-01168 5B

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W89-00460 6E

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Urban Runoff Simulation Model,
W89-00301 2E

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Estimation of the Risk Associated with the Organic Constituents of Hazardous and Municipal Waste Landfill Leachates,
W89-00995 5B

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Intrapedal Macropore Distribution and Infiltration Rate of Three Friona Polypedons,
W89-00408 2G

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Interaction of Earthen Liner Materials with Industrial Waste Leachate,
W89-00997 5E

Terrestrial Bioaccumulation Potential of Phenolic Compounds,
W89-00998 5B

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Look to the Future: Environmental Education,
W89-01121 5G

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Microbial Characterization of Municipal Wastewater at a Spray Irrigation Site: the Lubbock Infection Surveillance Study,
W89-01124 7B

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W89-00521 5G

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W89-00840 5F

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W89-00962 4A

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Comparative Study of Heavy Metals Pollution in Various Rivers and Lakes of Northern Greece,
W89-00571 5B

THESSALONIKI UNIV., SALONIKA (GREECE). FACULTY OF ENGINEERING.
Sensitivity Analysis of Closed-Form Analytical Hydraulic Conductivity Models,
W89-01204 2G

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Preconcentration of Heavy Metals in Natural Waters with Hydrazones Supported on Silica Gel,
W89-00568 5A

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Treatment of Dye-Containing Effluents with Different Bentonites,
W89-00615 5D

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W89-00205 4A

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W89-00633 5D

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W89-01050 2H

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W89-00402 2H

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W89-00212 2L

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Motor-Boat-Derived Volatile Organic Compounds (VOC) in Lake water,
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W89-00278 5F

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Coordinated Programme for Research and Monitoring of Pollution in the Mediterranean,
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Determination of Thiram in Water and Soils by Cathodic Stripping Voltammetry Based on Adsorptive Accumulation,
W89-01087 5A

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Effect of Mangrove Humic-Like Substances on Biodegradation Rate of Detritus,
W89-00476 2L

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W89-00404 5D

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Nutrient Release Through Decomposition of Diplodon Delodontus Expansus (Mollusca, Bivalvia) and Some Considerations of its Effects on the Ecology of a Small Tropical Reservoir,
W89-00009 2H

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W89-00090 2B

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W89-00006 2H

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W89-00007 2H

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W89-00768 2H

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W89-00646 5D

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W89-00010 2L

Mercury Inputs into the Amazon Region, Brazil,
W89-00637 5B

Heavy Metal Removal by Different Water Treatment Plants, in Rio de Janeiro State, Brazil,
W89-00647 5F

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W89-00693 5C

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W89-00197 2H

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W89-00898 8B

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W89-01031 5C

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W89-00155 5B

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W89-00271 5B

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Algal Studies of the River Ely, South Wales, U.K.: I. Phytoplankton,
W89-00678 2H

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W89-00679 2H

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W89-00725 2G

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W89-01020 2E

Identification of a Multiple Input, Single Output, Linear, Time Invariant Model for Hydrological Forecasting,
W89-01209 7C

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W89-00912 4C

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W89-00160 5A

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W89-01055 5B

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W89-01187 2H

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W89-00957 4A

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W89-00821 2L

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W89-00851 5C

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W89-00308 5B

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Influence of Altitude on Wet Deposition: Comparison between Field Measurements at Great Dun Fell and the Predictions of a Seeder-Feeder Model,
W89-01147 5B

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High Level Disinfection of Wastewaters for Reuse,
W89-00642 5D

UNIVERSITY OF PETROLEUM AND MINERALS, DHAHRAN (SAUDI ARABIA). WATER RESOURCES AND ENVIRONMENT DIV.
Flow Simulation Using Channel Network Model,
W89-00751 7B

UNIVERSITY OF SOUTH FLORIDA, ST. PETERSBURG.
Mechanisms of DNA Utilization by Estuarine Microbial Populations,
W89-00340 2L

UNIVERSITY OF SOUTHERN CALIFORNIA, LOS ANGELES.
Transient Pressures in Hydrotechnical Tunnels During Earthquakes,
W89-00448 8E

UNIVERSITY OF STRATHCLYDE, GLASGOW (SCOTLAND). DEPT. OF CIVIL ENGINEERING.
Water Movement and the Simulation of Storm Surges in the Firth of Clyde,
W89-00803 2L

UNIVERSITY OF STRATHCLYDE, GLASGOW (SCOTLAND). DEPT. OF GEOGRAPHY.
Climate of the Estuary and Firth of Clyde,
W89-00800 2L

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG (SOUTH AFRICA). DEPT. OF GEOLOGY AND BOTANY.
Roles of Sedimentation and Plant Growth in Changing Flow Patterns in the Okavango Delta, Botswana,
W89-00457 2J

UNIVERSITY OF WALES INST. OF SCIENCE AND TECHNOLOGY, CARDIFF.
Contribution of Plasmids to Naphthalene Catabolism in Sediment Bacteria,
W89-00378 5B

UPPSALA UNIV. (SWEDEN). DEPT. OF HYDROLOGY.
Distribution of Chlorinated Organic Substances from Pulp Mills,
W89-00359 5B

UPPSALA UNIV. (SWEDEN). INST. OF ECOLOGICAL BOTANY.
Demographic Study of Aerial Shoots of Carex rostrata in Relation to Water Level,
W89-00530 2H

UPPSALA UNIV. (SWEDEN). LIMNOLOGISKA INSTITUTIONEN.
Evaluation of Lake Restoration in Sweden,
W89-00021 5G

Photosynthesis of Submersed Macrophytes in Acidified Lakes: II. Carbon Limitation and Utilization of Benthic CO2 Sources,
W89-00095 5C

Community Grazing and the Regulation of In Situ Clearance and Feeding Rates of Planktonic Crustaceans in Lakes in the Kuokkel Area, Northern Sweden,
W89-00181 2H

Delayed Nutrient Responses to the Liming of Lake Gardsjon, Sweden,
W89-00441 5G

UTAH STATE UNIV., LOGAN. DEPT. OF CIVIL ENGINEERING.
Fate and Transport of Organics in Soil: Model Predictions and Experimental Results,
W89-01239 5B

UTAH STATE UNIV., LOGAN. DEPT. OF GEOLOGY.
Groundwater Flow Systems in Mountainous Terrain: 1. Numerical Modeling Technique,
W89-00708 2F

Groundwater Flow Systems in Mountainous Terrain: 2. Controlling Factors,
W89-00709 2F

UTAH UNIV., SALT LAKE CITY. DEPT. OF CIVIL ENGINEERING.
Optimization Model for Screening Multipurpose Reservoir Systems,
W89-00703 6A

UTRECHT RIJKSUNIVERSITEIT (NETHERLANDS). DEPT. OF PLANT ECOLOGY.
Nutrient Dynamics in Minerotrophic Peat Mires,
W89-00119 2H

UTRECHT RIJKSUNIVERSITEIT (NETHERLANDS). INST. VOOR METEOROLOGIE EN OCEANOGRAFIE.
Wet Deposition of Ammonium in Europe,
W89-00765 2B

VALTION TEKNILLINEN TUTKIMUSKESKUS, ESPOO (FINLAND). REAKTORILABORATORIO.
Determination of Total Organic Chlorine and Bromine in Water Samples by Adsorption onto Activated Carbon and Neutron Activation Analysis,
W89-00588 5A

VENICE UNIV. (ITALY). DEPT. OF ENVIRONMENTAL SCIENCE.
Comparison of Co-Digestion Performance of Two Differently Collected Organic Fractions of Municipal Solid Waste with Sewage Sludges,
W89-00643 5D

VICTORIA UNIV. (BRITISH COLUMBIA). DEPT. OF BIOLOGY.
Seasonal Variations and Spatial Gradients of Nitrogenous Nutrients in Waters of Southeastern Vancouver Island, British Columbia, Canada.
W89-00158 2L

VICTORIA UNIV. (BRITISH COLUMBIA). DEPT. OF GEOGRAPHY.
Politics of Hydro-Megaprojects: Damming with Faint Praise in Australia, New Zealand, and British Columbia,
W89-00836 6E

VILLANOVA UNIV., PA. DEPT. OF BIOLOGY.
Cycling of Inorganic and Organic Sulfur in Peat from Big Run Bog, West Virginia,
W89-00208 2H

VIRGINIA COOPERATIVE WILDLIFE RESEARCH UNIT, BLACKSBURG.
Habitat Suitability and Fish Production: A Model Evaluation for Rock Bass in Two Virginia Streams,
W89-00294 2H

VIRGINIA INST. OF MARINE SCIENCE, GLOUCESTER POINT.
Model of Zostera marina L. Photosynthesis and Growth: Simulated Effects of Selected Physical-Chemical Variables and Biological Interactions,
W89-00130 2L

VIRGINIA INST. OF MARINE SCIENCE, GLOUCESTER POINT. DIV. OF CHEMISTRY AND TOXICOLOGY.
Effects of High Levels of Polycyclic Aromatic Hydrocarbons on Sediment Physicochemical Properties and Benthic Organisms in a Polluted Stream,
W89-00589 5C

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. DEPT. OF AGRICULTURAL ENGINEERING.
Evaluation of Vegetation Filter Strips as a Best Management Practice for Feed Lots,
W89-01125 5G

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. DEPT. OF BIOLOGY.
Effect of a Heated Wastewater Discharge upon River Protozoan Species Pool Variability through Time and Space,
W89-00077 5C

Physiological Ecology of Bluegreen Algal Mats (Modern Stromatolites) in Antarctic Oasis Lakes,
W89-00185 2H

Metallothionein-Like Heavy Metal Binding Protein Levels in Asiatic Clams Are Dependent on the Duration and Mode of Exposure to Cadmium,
W89-01228 5B

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. DEPT. OF FISHERIES AND WILDLIFE SCIENCES.
Impacts of Navigation on Riverine Fish Production in the United States,
W89-00248 6G

Fish Production in the Kanawha River and its Relation To Barge Traffic,
W89-00249 6G

Application and Testing of an Index of Biotic Integrity in Small, Coolwater Streams,
W89-00323 2H

Effects of Temperature and Streamflow on Time and Duration of Spawning by Smallmouth Bass,
W89-00373 2H

VIRGINIA POLYTECHNIC INST., BLACKSBURG. WATER RESOURCES RESEARCH CENTER.
Pesticides: A Continuing Dilemma,
W89-01122 5B

VIRGINIA UNIV., CHARLOTTESVILLE. DEPT. OF CIVIL ENGINEERING.
Modeling Blue-Green Algal Blooms in the Lower Neuse River,
W89-01225 5C

VIRGINIA UNIV., CHARLOTTESVILLE. DEPT. OF ENVIRONMENTAL SCIENCES.
Local Influences on the Composition of Precipitation on Bermuda,
W89-00405 2A

Interactions Between Groundwater Seepage and Sediment Porewater Sulphate Concentration Profiles in Lake Anna, Virginia,
W89-00910 5B

Chemical Evolution of a Travertine-Depositing Stream: Geochemical Processes and Mass Transfer Reactions,
W89-01250 2K

VRIJE UNIV., AMSTERDAM (NETHERLANDS). DEPT. OF ANALYTICAL CHEMISTRY.
Determination of Polychlorinated Dibenzofurans in Surface Water by Means of Liquid Chromatography Using on-Line Sample Preconcentration and Different Spectroscopic Detection Techniques,
W89-00590 5A

VRIJE UNIV., AMSTERDAM (NETHERLANDS). DEPT. OF METEOROLOGY.
Heat Balance of a Tidal Flat Area,
W89-00148 2L

VSEROSSIISKII NAUCHNO-ISSLEDOVATEL'SKII INST. PRUDOVOGO RYBNOGO KHOZYAISTVA, KONAKOVO (USSR).
State of the Ichthyofauna in Istrinsk Reservoir Since Its Conversion into a Recreational Water,
W89-01191 2H

VYSKUMNY USTAV VODOHOSPODARSKY, BRATISLAVA (CZECHOSLOVAKIA).
Radioactivity of the Czechoslovakian Reach of the Danube River (Die Radioaktivitat im tschechoslowakischen Donauabschnitt),
W89-00171 5B

WAHNBACHTALSPERRENVERBAND, SIEGBURG (GERMANY, F.R.).
Strategies of Lake Sanitation,
W89-00017 5G

Chemical Methods of P-Elimination in the Tributaries of Reservoirs and Lakes,
W89-00020 5G

WARSAW UNIV. (POLAND). DEPT. OF HYDROBIOLOGY.
Sources and Fate of Detritus in the Shore Zone of Lakes,
W89-00121 2H

WARSAW UNIV. (POLAND). DEPT .OF PHYTOGEOGRAPHY.
Habitat Requirements and Bioindicator Value of the Main Communities of Aquatic Vegetation in North-East Poland,
W89-00235 2H

Differentiation of the Physical and Chemical Properties of Bottom Sediments in Phytocenoses of Myriophylletum verticillati Soo 1927, Potamogetonetum natantis Soo 1927 and Hydrocharitetum morsus-ranae Langendonck 1935 Associations,
W89-00259 2H

WARSAW UNIV. (POLAND). INST. OF PHYSICAL GEOGRAPHIC SCIENCES.
Natural Degradation Ability of Lakes and the Role of Drainage Area in the Process (Ocena naturalnej podatnosci jezior na degradacje i rola zlewni u tym procesie),
W89-00032 2H

WASHINGTON STATE UNIV., PULLMAN. DEPT. OF MECHANICAL ENGINEERING.
Dispersion in Heterogeneous Porous Media: 1. Local Volume Averaging and Large-Scale Averaging,
W89-00699 5B

Dispersion in Heterogeneous Porous Media: 2. Predictions for Stratified and Two-Dimensional Spatially Periodic Systems,
W89-00700 5B

WASHINGTON STATE UNIV., PUYALLUP. WESTERN WASHINGTON RESEARCH AND EXTENSION CENTER.
Septic System Performance on a Coastal Barrier Island,
W89-01163 5D

WASHINGTON UNIV., SEATTLE. DEPT. OF BIOSTATISTICS.
Tau-Like Test for Trend in the Presence of Multiple Censoring Points,
W89-00865 7C

WASHINGTON UNIV., SEATTLE. DEPT. OF CIVIL ENGINEERING.
Changes in Rainwater Acidity Associated with Closure of a Copper Smelter,
W89-00272 5B

Multivariate Nonparametric Tests for Trend in Water Quality,
W89-00863 7C

Effects of Cyanide and Polyphosphates on Adsorption of Metals from Simulated and Real Mixed-Metal Plating Wastes,
W89-01219 5D

WASHINGTON UNIV., SEATTLE. SCHOOL OF FISHERIES.
Toxicity of Sea-Surface Microlayer: Effects of Hexane Extract on Baltic Herring (Clupea harengus) and Atlantic Cod (Gadus morhua) Embryos,
W89-00856 5C

WASHINGTON UNIV., SEATTLE. SCHOOL OF OCEANOGRAPHY.
Clouds, Deep Chlorophyll Maxima and the Nutrient Supply to the Mixed Layer of Stratified Water Bodies,
W89-00227 2L

WATER AND SEWAGE AUTHORITY, CASTRIES (ST. LUCIA).
Twinning: Utility Pairing,
W89-00424 5F

WATER AUTHORITY OF WESTERN AUSTRALIA, PERTH.
Effect of Logging and Regeneration on Groundwater, Streamflow and Stream Salinity in the Southern Forest of Western Australia,
W89-00350 4C

Kinetics of Sulfide Oxidation by Dissolved Oxygen,
W89-01130 5D

WATER RESEARCH CENTRE, MEDMENHAM (ENGLAND).
Determination of Organotins in Natural Waters by Toluene Extraction and Graphite Furnace AAS,
W89-00743 5A

WATER REUSE PROMOTION CENTRE, TOKYO (JAPAN).
Experiments on Seawater Desalination by Membrane Distillation,
W89-01063 3A

WATERLOO UNIV. (ONTARIO). DEPT. OF BIOLOGY.
Prediction of Rainbow Trout Embryo Survival in Relation to Groundwater Seepage and Particle Size of Spawning Substrates,
W89-00326 2H

Microcomputer-Based Measurement of Algal Fluorescence as a Potential Indicator of Environmental Contamination,
W89-01157 5A

WATERLOO UNIV. (ONTARIO). DEPT. OF SYSTEMS DESIGN ENGINEERING.
Nonparametric Approaches to Environmental Impact Assessment,
W89-00861 7C

Data Analysis of Water Quality Time Series in Lake Erie,
W89-00866 7C

WATERLOO UNIV. (ONTARIO). INST. FOR GROUND WATER RESEARCH.
Hydrogeology of Two Saskatchewan Tills. I. Fractures, Bulk Permeability, and Spatial Variability of Downward Flow,
W89-01201 2F

Hydrogeology of Two Saskatchewan Tills. II. Occurrence of Sulfate and Implications for Soil Salinity,
W89-01202 2F

WATERWAYS EXPERIMENT STATION, VICKSBURG, MS.
Flocculent Settling above Zone Settling Interface,
W89-00484 5E

WATERWORKS AUTHORITY, BANGKOK (THAILAND).
Improving Water Supply in Thailand,
W89-00422 5F

WATTS REGULATOR CO., NORTH ANDOVER, MA.
Valves for Controlling Pressure, Flow and Level,
W89-01102 5F

WEIZMANN INST. OF SCIENCE, REHOVOTH (ISRAEL). DEPT. OF ISOTOPE RESEARCH.
Microscale Haline Convection - A Proposed Mechanism for Transport and Mixing at the Water Table Region,
W89-00718 2F

WELSH WATER AUTHORITY, POWYS.
Regulation of the River Dee,
W89-00953 4A

WEST VIRGINIA UNIV., MORGANTOWN.
Effects of Acidification and Phosphorus Addition on Phytoplankton Biomass and Productivity in a Circum-Neutral Mesotrophic Lake Receiving Acid Precipitation,
W89-00179 2H

WEST VIRGINIA UNIV., MORGANTOWN. DEPT. OF BIOLOGY.
Effect of Low pH on Survival of Brook Trout Embryos and Yolk-Sac Larvae in West Virginia Streams,
W89-00293 5C

WEST VIRGINIA UNIV., MORGANTOWN. DIV. OF PLANT AND SOIL SCIENCES.
Metabolic Processes Involved in Repair of Escherichia coli Cells Damaged by Exposure to Acid Mine Water,
W89-00727 5C

WESTERN AUSTRALIA UNIV., NEDLANDS. CENTRE FOR WATER RESEARCH.
Thermal Simulation of a Lake with Winter Ice Cover,
W89-01044 2H

WESTERN AUSTRALIA UNIV., NEDLANDS. DEPT. OF BOTANY.
Correlations between Salinity and Growth of the Seagrass Amphibolis antarctica (Labill.) Sonder & Aschers., in Shark Bay, Western Australia, Using a New Method for Measuring Production Rate,
W89-00102 2L

Loss of Seagrass in Cockburn Sound, Western Australia: II. Possible Causes of Seagrass Decline,
W89-00116 5C

Nutrient Levels and the Development of Diatom and Blue-Green Blooms in a Shallow Australian Estuary,
W89-00211 2H

WESTON (ROY F.), INC., ALBUQUERQUE, NM.
Reliability of Chemical Analyses of Water Samples: The Experience of the UMTRA Project,
W89-00941 5A

WINDSOR UNIV. (ONTARIO). GREAT LAKES INST.
Influence of an Arctic Large-Lakes System on Mesoclimate in South-Central Baffin Island, N.W.T., Canada,
W89-00437 2H

WINNIPEG UNIV. (MANITOBA). DEPT. OF BIOLOGY.
Ecology of Freshwater Gastropods in the Central Canadian Region,
W89-01183 2H

WISCONSIN DEPT. OF NATURAL RESOURCES, MADISON.
Disposal of Radium Removed from Drinking Water,
W89-01106 5E

WISCONSIN STATE LAB. OF HYGIENE, MADISON.
Evaluating the Modifications to the MF Total Coliform Method for Drinking Water with High Noncoliform Backgrounds,
W89-00427 5A

WISCONSIN UNIV.-LA CROSSE. RIVER STUDIES CENTER.
Biomass and Nutritive Potential of Vallisneria americana Michx in Navigation Pool 9 of the Upper Mississippi River,
W89-00093 2H

Effects of Acidification on Mercury Methylation, Demethylation, and Volatilization in Sediments from an Acid-Susceptible Lake,
W89-00731 5B

WISCONSIN UNIV., MADISON. DEPT. OF BOTANY.
Effects of Light and Temperature on Photosynthesis of the Nuisance Alga Cladophora glomerata (L.) Kutz from Green Bay, Lake Michigan,
W89-00848 2H

WISCONSIN UNIV.-MADISON. DEPT. OF URBAN AND REGIONAL PLANNING.
Assessing Networked Coastal Zone Management Programs,
W89-00290 6B

WISCONSIN UNIV.-MADISON. SPACE SCIENCE AND ENGINEERING CENTER.
Determining Microwave Brightness Temperatures from Precipitating Horizontally Finite and Vertically Structured Clouds,
W89-01263 7B

WISCONSIN UNIV.-MADISON. WATER CHEMISTRY LAB.
Sampling Strategies and Associated Errors in Estimating Epilimnetic Chlorophyll in Eutrophic Lakes,
W89-01242 2H

WISCONSIN UNIV.-MADISON. WATER RESOURCES CENTER.
Transport Modelling of Biological Tracers from Septic Systems,
W89-01226 5B

WISCONSIN UNIV., MILWAUKEE. CENTER FOR GREAT LAKES STUDIES.
Manganese Oxidation in pH and O2 Microenvironments Produced by Phytoplankton,
W89-01045 2K

WISCONSIN UNIV.-MILWAUKEE. DEPT. OF BIOLOGICAL SCIENCES.
Phagotrophic Phototrophs: The Ecological Significance of Mixotrophy,
W89-00384 2H

Assessment of Selenium Toxicity in Algae Using Turbidostat Culture,
W89-01230 5C

WISCONSIN UNIV.-SUPERIOR. CENTER FOR LAKE SUPERIOR ENVIRONMENTAL STUDIES.
Comparison of Chemical Biodegradation Rates in BOD Dilution and Natural Waters,
W89-01158 5B

WOODS HOLE OCEANOGRAPHIC INSTITUTION, MA.
Shear Instability in a Highly Stratified Estuary,
W89-00415 2L

WOODS HOLE OCEANOGRAPHIC INSTITUTION, MA. DEPT. OF BIOLOGY.
Dynamics of Protistan Carbon and Nutrient Cycling,
W89-00383 2L

WORLD HEALTH ORGANIZATION, GENEVA (SWITZERLAND).
Water Supply and Sanitation - Cornerstones of the World Health Organization's Forty Years of International Health Development,
W89-00917 5F

WRIGHT STATE UNIV., DAYTON, OH. DEPT. OF GEOLOGICAL SCIENCE.
Tracer Test Analysis of Anisotropy in Hydraulic Conductivity of Granular Aquifers,
W89-00940 2F

WUHAN UNIV. (CHINA). DEPT. OF CHEMISTRY.
Determination of Free Cyanide in Water by Released Fluorescence of a Dissociated Ternary Complex,
W89-00477 5A

WYOMING UNIV., LARAMIE. DEPT. OF AGRICULTURAL ENGINEERING.
Analyses of Equations for Free Water Evaporation Estimates,
W89-00705 2D

WYZSZA SZKOLA NAUCZYCIELSKA W SLUPSKU (POLAND). DEPT. OF CHEMISTRY.
Chemical Characteristics of Bottom Sediment Top Layer in Szczytno Male Lake,
W89-00237 2H

Primary Production in Lakes with Cage Trout Culture,
W89-00238 2H

Sorption of Cations by Bottom Sediments of Szczytno Male and Letowo Lakes, with Cage Trout Culture,
W89-00239 2H

Nitrogen and Phosphorus Balance in Lake Szczytno Male,
W89-00240 2H

Hydrochemical Study of Lake Szczytno Male With Trout Cage Culture,
W89-00241 5B

Sorption Properties of Bottom Sediments of Szczytno Male and Letowo Lakes,
W89-00256 2H

Chlorophyll Relationships in Letowo and Szczytno Male Lakes, with Trout Cage Culture,
W89-00262 2H

WYZSZA SZKOLA PEDAGOGICZNA, OLSZTYN-KORTOW (POLAND).
Simple Self-Acting Hydrobiological Sampler (Prosty samoczynny czerpacz hydrobiologiczny),
W89-00033 7B

YALE UNIV., NEW HAVEN, CT. SCHOOL OF MEDICINE.
National Field Evaluation of a Defined Substrate Method for the Simultaneous Enumeration of Total Coliforms and Escherichia coli from Drinking Water: Comparison with the Standard Multiple Tube Fermentation Method,
W89-00337 5A

YAMANASHI UNIV., KOFU (JAPAN). DEPT. OF CHEMISTRY.
Continuous-flow System for the Determination of Cobalt in Sea and River Water: In-line Preconcentration/Separation Coupled with Catalytic Determination,
W89-00063 5A

YELLOW SEA FISHERIES RESEARCH INST., QINGDAO (CHINA).
Catalytic Determination of Copper in Natural Water at Microgram/L Level by Flow Injection Analysis, (in Chinese),
W89-00201 7B

YORK UNIV., NORTH YORK (ONTARIO). DEPT. OF GEOGRAPHY.
Runoff Generation in a Low Arctic Drainage Basin,
W89-01207 2A

ZENTNER AND ZENTNER, SAN FRANCISCO, CA.
Wetland Projects of the California State Coastal Conservancy: An Assessment,
W89-01069 6E

ZOOLOGISCHES INST. UND MUSEUM, HAMBURG (GERMANY, F.R.).
Soft Bottom Fauna Near the River Elbe Estuary under the Influence of Sewage Sludge. I. Seasonal Variation of Species Number, Abundance and Biomass in Relation to Sediment Structure (Die Weichbodenfauna vor der Elbemuendung unter dem Einfluss der Klaerschlammverklappung. I. Die Saisonale Veraenderung von Arten- und Individuenzahl sowie Biomasse unter Beruecksichtigung der Sedimentstrucktur),
W89-00316 5C

ZURICH UNIV., KILCHBERG (SWIZERLAND). HYDROBIOLOGICAL-LIMNOLOGICAL STATION.
Periphyton Diatom Communities and Trophic States of Three Shallow Lakes in the Pfynwald Region of Canton Valais, Switzerland,
W89-00195 2H

ZURICH UNIV. (SWITZERLAND). ZOOLOGICAL MUSEUM.
Dynamics of Hydra Populations in Lake Zurich, Switzerland, and Lake Maggiore, Italy,
W89-00692 2H

ACCESSION NUMBER INDEX

W89-00001 2L
W89-00002 2H
W89-00003 2J
W89-00004 2L
W89-00005 2L
W89-00006 2H
W89-00007 2H
W89-00008 5A
W89-00009 2H
W89-00010 2L
W89-00011 2H
W89-00012 2H
W89-00013 2H
W89-00014 2H
W89-00015 5G
W89-00016 5G
W89-00017 5G
W89-00018 2H
W89-00019 5G
W89-00020 5G
W89-00021 5G
W89-00022 2H
W89-00023 2H
W89-00024 5B
W89-00025 2H
W89-00026 2E
W89-00027 2H
W89-00028 5C
W89-00029 2H
W89-00030 5C
W89-00031 5C
W89-00032 2H
W89-00033 7B
W89-00034 8C
W89-00035 8E
W89-00036 8D
W89-00037 8E
W89-00038 8E
W89-00039 8A
W89-00040 8C
W89-00041 2J
W89-00042 8C
W89-00043 8G
W89-00044 8C
W89-00045 8F
W89-00046 2J
W89-00047 2A
W89-00048 5C
W89-00049 8A
W89-00050 3B
W89-00051 8A
W89-00052 8C
W89-00053 8C
W89-00054 8C
W89-00055 8C
W89-00056 8D
W89-00057 8A
W89-00058 8A
W89-00059 8C
W89-00060 8C
W89-00061 8F
W89-00062 10C
W89-00063 5A
W89-00064 7B
W89-00065 7B
W89-00066 7B
W89-00067 8B
W89-00068 8H
W89-00069 8I
W89-00070 8D
W89-00071 8E
W89-00072 2J
W89-00073 8B
W89-00074 8C
W89-00075 8G
W89-00076 8A
W89-00077 5C
W89-00078 5C
W89-00079 5C
W89-00080 2H
W89-00081 5C
W89-00082 5B
W89-00083 5D
W89-00084 5B
W89-00085 5C
W89-00086 5C
W89-00087 5C
W89-00088 3B
W89-00089 3B
W89-00090 2B
W89-00091 3B
W89-00092 2H
W89-00093 2H
W89-00094 5C
W89-00095 5C
W89-00096 2H
W89-00097 2H
W89-00098 2H
W89-00099 2H
W89-00100 2H
W89-00101 5C
W89-00102 2L
W89-00103 5C
W89-00104 2L
W89-00105 4A
W89-00106 5B
W89-00107 5D
W89-00108 2H
W89-00109 5D
W89-00110 5B
W89-00111 2H
W89-00112 5C
W89-00113 2H
W89-00114 2H
W89-00115 2L
W89-00116 5C
W89-00117 4A
W89-00118 2H
W89-00119 2H
W89-00120 2L
W89-00121 2H
W89-00122 2H
W89-00123 5A
W89-00124 2H
W89-00125 2D
W89-00126 2H
W89-00127 5C
W89-00128 2H
W89-00129 5C
W89-00130 2L
W89-00131 2H
W89-00132 5C
W89-00133 4D
W89-00134 5F
W89-00135 5C
W89-00136 5D
W89-00137 2H
W89-00138 2H
W89-00139 5C
W89-00140 2L
W89-00141 2L
W89-00142 2L
W89-00143 5B
W89-00144 2H
W89-00145 3C
W89-00146 2H
W89-00147 2H
W89-00148 2L
W89-00149 5B
W89-00150 5C
W89-00151 2L
W89-00152 2L
W89-00153 2L
W89-00154 5B
W89-00155 5B
W89-00156 2L
W89-00157 2L
W89-00158 2L
W89-00159 5C
W89-00160 5A
W89-00161 2L
W89-00162 2H
W89-00163 2H
W89-00164 4A
W89-00165 5C
W89-00166 2H
W89-00167 2H
W89-00168 5B
W89-00169 7B
W89-00170 5B
W89-00171 5B
W89-00172 2E
W89-00173 6G
W89-00174 5A
W89-00175 5C
W89-00176 2H
W89-00177 2H
W89-00178 2H
W89-00179 2H
W89-00180 5B
W89-00181 2H
W89-00182 2H
W89-00183 5B
W89-00184 2H
W89-00185 2H
W89-00186 5C
W89-00187 2H
W89-00188 2H
W89-00189 5C
W89-00190 2H
W89-00191 5C
W89-00192 5A
W89-00193 2H
W89-00194 5A
W89-00195 2H
W89-00196 2H
W89-00197 2H
W89-00198 2H
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W89-01112 6E
W89-01113 5F
W89-01114 5F
W89-01115 5F
W89-01116 5G
W89-01117 5F
W89-01118 5F
W89-01119 5A
W89-01120 5F
W89-01121 5G
W89-01122 5B
W89-01123 6D
W89-01124 7B
W89-01125 5G
W89-01126 5D
W89-01127 5D
W89-01128 5D
W89-01129 5D
W89-01130 5D
W89-01131 5D
W89-01132 6C
W89-01133 5D
W89-01134 5G
W89-01135 5G
W89-01136 5D
W89-01137 5D
W89-01138 5D
W89-01139 5D
W89-01140 5E
W89-01141 2D
W89-01142 2E
W89-01143 2E
W89-01144 2E
W89-01145 2F
W89-01146 5B
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W89-01148 5B
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W89-01151 5B
W89-01152 2B
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W89-01154 5C
W89-01155 5G
W89-01156 5C
W89-01157 5A
W89-01158 5B
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W89-01162 5A
W89-01163 5D
W89-01164 5B
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W89-01167 5C
W89-01168 5B
W89-01169 5E
W89-01170 5B
W89-01171 5D
W89-01172 8E
W89-01173 8H
W89-01174 8D
W89-01175 8B
W89-01176 8D
W89-01177 8B
W89-01178 2F
W89-01179 8C
W89-01180 8D
W89-01181 8C
W89-01182 8F
W89-01183 2H
W89-01184 5G
W89-01185 5D
W89-01186 2H
W89-01187 2H
W89-01188 5G
W89-01189 6E
W89-01190 6E
W89-01191 2H
W89-01192 6G
W89-01193 3C
W89-01194 2H
W89-01195 7B
W89-01196 2F
W89-01197 2F
W89-01198 7C
W89-01199 7C
W89-01200 2A
W89-01201 2F
W89-01202 2F
W89-01203 2C
W89-01204 2G
W89-01205 2F
W89-01206 5C
W89-01207 2A
W89-01208 7C
W89-01209 7C
W89-01210 5B
W89-01211 2J
W89-01212 3B
W89-01213 2E
W89-01214 2F
W89-01215 5A
W89-01216 5A
W89-01217 5D
W89-01218 5D
W89-01219 5D
W89-01220 5A
W89-01221 5F
W89-01222 5F
W89-01223 5B
W89-01224 5A
W89-01225 5C
W89-01226 5B
W89-01227 5B
W89-01228 5B
W89-01229 5F
W89-01230 5C
W89-01231 2H
W89-01232 2L
W89-01233 5G
W89-01234 5D
W89-01235 5D
W89-01236 5C
W89-01237 5F
W89-01238 5D
W89-01239 5B
W89-01240 5F
W89-01241 5F
W89-01242 2H
W89-01243 2F
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W89-01245 2F
W89-01246 2E
W89-01247 2B
W89-01248 2A
W89-01249 5B
W89-01250 2K
W89-01251 5D
W89-01252 6E
W89-01253 6E
W89-01254 8C
W89-01255 8C
W89-01256 5D
W89-01257 5B
W89-01258 5B
W89-01259 5B
W89-01260 2C
W89-01261 2C
W89-01262 2A
W89-01263 7B
W89-01264 5B
W89-01265 5C
W89-01266 6E
W89-01267 6E
W89-01268 6E
W89-01269 6E

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1 **NATURE OF WATER**

2 **WATER CYCLE**

3 **WATER SUPPLY AUGMENTATION AND CONSERVATION**

4 **WATER QUANTITY MANAGEMENT AND CONTROL**

5 **WATER QUALITY MANAGEMENT AND PROTECTION**

6 **WATER RESOURCES PLANNING**

7 **RESOURCES DATA**

8 **ENGINEERING WORKS**

9 **MANPOWER, GRANTS, AND FACILITIES**

10 **SCIENTIFIC AND TECHNICAL INFORMATION**

INDEXES

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSSION NUMBER INDEX

1989 Price Schedules for the United States, Canada, and Mexico

These prices are for customers in the United States, Canada, and Mexico; other customers, write for price list PR-360-4.

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D03	125	T03	325
D04	175	T04	425
D05	225	T05	525
D06	275	T06	625
D07	325	T07	725
D08	375	T08	825
D09	425	T09	925
D10	475	T10	1,025
D11	525	T11	1,125
D12	575	T12	1,225
D13	625	T13	1,325
D14	675	T14	1,425
D15	725	T15	1,525
D16	775	T16	1,625
D17	825	T17	1,725
D18	875	T18	1,825
D19	925	T19	1,925
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